IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 8, May 2026
Impact Factor: 8.2

A Comprehensive Review on: Banana and Pomegranate Peel-Based Anti-Aging Cream

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Abstract: *Topical formulations can help reduce oxidative stress in the skin. Banana peel, an agricultural waste product, possesses antioxidant properties but has not been widely utilized in topical applications. This study aimed to assess the antioxidant and anti-aging potential of a cream containing lyophilized banana peel extract. Skin aging is a complex biological phenomenon marked by a progressive loss of the skin's structural strength and functional efficiency. It is affected by internal factors such as genetics and hormonal variations, as well as external influences like ultraviolet (UV) exposure, environmental pollution, and daily lifestyle practices. A key contributor to this process is oxidative stress, which leads to the production of reactive oxygen species (ROS). These reactive molecules accelerate cellular injury, break down collagen, and promote the development of wrinkles and fine lines. In recent times, there has been increasing attention toward the use of herbal and naturally derived topical formulations, as they are considered safer and more environmentally friendly alternatives to conventional synthetic anti-aging products. In summary, the developed anti-aging cream enriched with banana and pomegranate peel extracts exhibits considerable antioxidant activity along with notable benefits for skin health. This formulation serves as a natural, reliable, and economical substitute for traditional synthetic anti-aging products. Nevertheless, comprehensive investigations, including detailed clinical evaluations and extended stability studies, are necessary to confirm its effectiveness and suitability for large-scale commercialization. Overall, this research adds valuable insight to the growing domain of herbal cosmetology and encourages the incorporation of plant-derived bioactive compounds into contemporary skincare systems.*

Keywords: Anti-wrinkle activity, Anti-aging , Banana peel , Pomegranate peel, Oxidative stress, Natural antioxidants, Herbal anti-aging cream, Anti-photoaging, Herbal skincare.

I. INTRODUCTION

Anti aging cream-

Herbal anti-aging creams are considered natural topical preparations formulated to minimize, slow down, and control the visible effects of skin aging, including wrinkles, fine lines, dryness, uneven pigmentation, and reduced elasticity, through the use of plant-based bioactive substances that provide both therapeutic and cosmetic advantages. The aging of skin is a progressive and multifaceted biological phenomenon driven by internal factors such as genetic constitution, hormonal variations, and metabolic processes, as well as external influences like continuous exposure to ultraviolet (UV) rays, environmental contaminants, smoking, psychological stress, and unhealthy lifestyle choices. Among these contributors, oxidative stress plays a dominant role by promoting the formation of reactive oxygen species (ROS), which cause cellular damage, break down collagen and elastin structures, and hasten the aging process, leading to the appearance of dull, loose, and wrinkled skin.

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The development of herbal anti-aging creams typically centers on creating an oil-in-water emulsion, in which the oil phase—comprising substances like stearic acid, cetyl alcohol, and various natural oils—is blended with the aqueous phase that includes water and plant-derived extracts. Following this, components such as humectants (e.g., glycerin) are incorporated to maintain moisture, along with preservatives to prevent microbial contamination, and occasionally natural fragrances to improve consumer appeal.

The entire process demands precise regulation of temperature, thorough mixing, and proper homogenization to produce a stable, consistent, and visually appealing formulation. After preparation, the cream is subjected to multiple evaluation procedures to verify its quality, safety, and performance. These assessments include measuring pH to ensure skin compatibility, determining viscosity and spreadability for ease of use, and conducting stability studies to examine resistance to separation and degradation under varying conditions. Additionally, skin irritation tests are performed to confirm its safety for topical application, while antioxidant capacity is often analyzed through in vitro methods to establish its ability to neutralize free radicals. Herbal anti-aging creams are designed to combat these harmful effects mainly through their antioxidant, anti-inflammatory, hydrating, and photoprotective actions, thereby serving as a safer and more eco-friendly substitute for conventional synthetic skincare products, which often contain harsh chemicals and may lead to adverse effects with long-term use. Such formulations generally include a wide range of medicinal plant extracts that are rich in bioactive constituents like polyphenols, flavonoids, tannins, vitamins, and essential oils. These compounds act together to scavenge free radicals, promote collagen production, improve skin firmness, and retain moisture balance.

II. UNDERSTANDING SKIN AGING

Skin aging is a multifaceted and progressive biological phenomenon that leads to both visible and structural alterations in the skin over time. It is commonly marked by signs such as wrinkles, fine lines, dryness, reduced elasticity, uneven skin tone, and thinning of the skin layers. These changes arise from the combined influence of internal (intrinsic) factors and external (extrinsic) elements, which impact the skin at cellular, molecular, and structural levels.

Types:

1. Intrinsic aging-

Intrinsic aging, often referred to as chronological aging, is an inevitable and naturally occurring process that develops over time as a result of internal bodily mechanisms. It is largely determined by an individual's genetic profile and is shaped by physiological processes such as cellular activity, hormonal fluctuations, and a progressive reduction in the skin's ability to repair and renew itself. In contrast to extrinsic aging, it occurs independently of environmental influences and advances gradually as part of the normal aging process.

2. Extrinsic aging-

Extrinsic aging, in contrast, results from external influences and lifestyle habits that speed up the normal aging process of the skin. The primary factor responsible is long-term exposure to ultraviolet (UV) rays from the sun, commonly known as photoaging. These UV rays penetrate deep into the skin and stimulate the production of reactive oxygen species (ROS), which trigger oxidative damage to important cellular components such as DNA, proteins, and lipids. As a consequence, collagen fibers are degraded, leading to the development of wrinkles and uneven pigmentation. In addition, environmental pollutants, smoking, unhealthy diet, psychological stress, and inadequate skincare practices further intensify skin damage and accelerate the aging process.

Mechanism of Anti-Aging Action:

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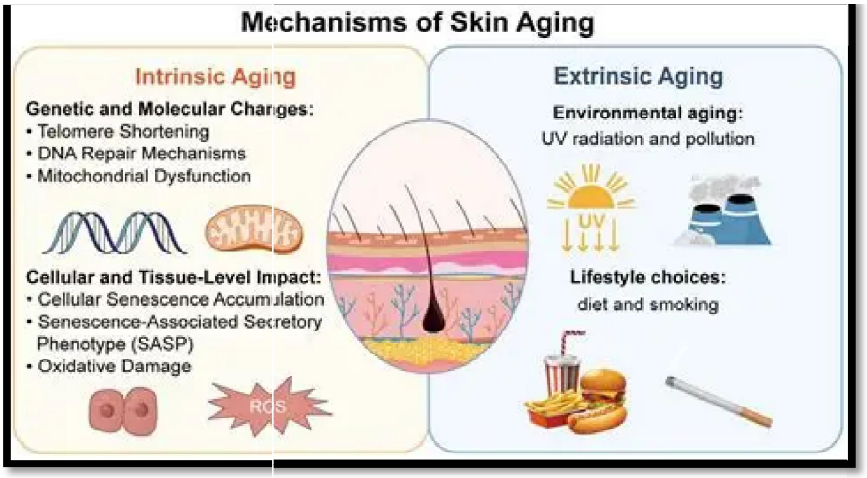

Fig.No.1

The anti-aging effect of herbal creams made from banana peel and pomegranate peel is primarily attributed to their potent antioxidant properties. These natural sources contain high levels of polyphenols, flavonoids, vitamins, and other active phytochemicals that effectively neutralize reactive oxygen species (ROS). Since ROS are major contributors to oxidative stress, they cause damage to skin cells, proteins, and DNA, thereby accelerating skin aging. By eliminating these free radicals, the formulation helps reduce cellular damage and delays the development of wrinkles, fine lines, and other signs of aging. Moreover, these extracts protect collagen and elastin structures by blocking enzymes such as matrix metalloproteinases (MMPs), which are responsible for their degradation.

In addition, the anti-aging mechanism also involves anti-inflammatory, photoprotective, and regenerative actions. The bioactive compounds help reduce inflammation triggered by UV exposure, pollution, and environmental stress, thereby minimizing long-term skin damage. They also protect the skin from UV-induced photoaging, which is associated with pigmentation and reduced elasticity. Furthermore, these herbal ingredients enhance skin renewal by supporting cell repair, improving moisture retention, and boosting overall skin quality. Collectively, these effects maintain skin firmness, elasticity, and a youthful appearance while effectively slowing down the aging process.

Signs of Skin Aging:

1. Development of fine lines on facial skin.
2. Gradual appearance of deep wrinkles.
3. Decrease in skin elasticity and firmness.
4. Increased dryness and reduced moisture levels in skin.
5. Uneven complexion with pigmentation issues.
6. Dull, fatigued, and lackluster skin appearance.

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Fig. No.2

Objectives :

1. To formulate a herbal anti-aging cream using extracts of banana peel and pomegranate peel.
2. To make effective use of fruit peel waste as a source of valuable cosmetic bioactive compounds.
3. To analyze the antioxidant capacity of banana and pomegranate peel extracts.
4. To investigate the ability of the formulation to reduce oxidative stress in the skin.
5. To promote collagen synthesis and improve skin firmness and elasticity.
6. To minimize visible aging signs such as wrinkles, fine lines, and skin sagging.
7. To evaluate the anti-inflammatory activity of the developed cream.
8. To ensure protection of the skin against UV-induced damage (photoprotection).
9. To prepare a stable, safe, and skin-compatible topical formulation.
10. To design an economical and environmentally friendly alternative to synthetic anti-aging products.

III. ROLE OF HERBAL INGREDIENTS IN ANTI-AGING:

Herbal anti-aging creams contain a variety of natural bioactive compounds that act on different processes responsible for skin aging.

1. Antioxidant Activity -

Anti-aging creams that contain antioxidants function by counteracting free radicals, thereby minimizing or preventing oxidative damage. These antioxidants stabilize reactive oxygen species (ROS) by donating electrons, which interrupts the chain reactions responsible for cellular harm. Consequently, they safeguard the skin's structural framework, preserve collagen content, and delay the appearance of aging signs. This protective effect also enhances skin firmness, improves elasticity, and promotes a smoother, healthier texture. Antioxidant activity is a key factor in determining the efficacy of anti-aging creams, as it directly addresses oxidative stress, one of the primary drivers of skin aging. The skin is continually subjected to damaging external influences such as ultraviolet (UV) rays, environmental pollution, and toxins, which promote the generation of reactive oxygen species (ROS), also referred to as free radicals. These highly reactive molecules attack vital cellular components including DNA, proteins, and lipids, leading to the degradation of collagen and elastin fibers.

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2. Collagen Enhancement-

Anti-aging creams are designed to boost the production of collagen while also preventing the breakdown of existing collagen fibers. They often include active compounds that stimulate fibroblasts, the cells responsible for synthesizing collagen and elastin in the skin. By enhancing the activity of these cells, such creams support the renewal of the skin's structural framework, leading to increased firmness and a noticeable reduction in wrinkles. Along with promoting collagen synthesis, anti-aging creams also play a role in protecting collagen from degradation. External factors like ultraviolet (UV) exposure can stimulate enzymes known as matrix metalloproteinases (MMPs), which break down collagen fibers. Antioxidant-rich ingredients help suppress the activity of these enzymes and shield collagen from oxidative harm, thereby maintaining the skin's structural integrity.

3. Anti-inflammatory Effects-

Anti-inflammatory action is a vital component of anti-aging creams because inflammation significantly contributes to early skin aging, a process often termed "inflammaging." The skin is continuously exposed to harmful agents such as ultraviolet (UV) rays, environmental pollutants, allergens, and aggressive chemicals, all of which can provoke inflammatory reactions. These reactions stimulate the release of pro-inflammatory substances like cytokines and certain enzymes that harm skin cells, break down collagen, and speed up the development of wrinkles, redness, and uneven complexion. Anti-aging formulations with anti-inflammatory properties help soothe and calm the skin by limiting the production of these inflammatory substances. They function by blocking the biological pathways responsible for inflammation, thereby reducing irritation, redness, and swelling. This protective mechanism helps preserve the skin's structure over time and slows the progression of visible aging signs.

4. Photoprotection-

Photoprotection is the capacity of anti-aging creams to defend the skin against the damaging impact of ultraviolet (UV) radiation, a major factor responsible for early skin aging, often termed photoaging. Prolonged exposure to UV rays—particularly UVA and UVB—can penetrate the skin layers and stimulate the formation of reactive oxygen species (ROS), leading to oxidative stress. This process damages vital cellular components, weakens collagen and elastin fibers, and contributes to the appearance of wrinkles, fine lines, uneven pigmentation, and reduced skin elasticity. Anti-aging creams with photoprotective effects help guard the skin from UV-related damage through multiple mechanisms. Certain formulations include physical or chemical sunscreens that either reflect or absorb UV radiation, thereby limiting its penetration into the skin. Additionally, many herbal-based creams are enriched with natural antioxidants that counteract ROS produced by UV exposure, reducing oxidative damage and helping to delay the onset of premature aging.

IV. COMMON HERBAL INGREDIENTS USED IN ANTI-AGING CREAM:

1.Banana peel:

Banana peel, derived from Musa paradisiaca, is a largely overlooked natural material that is now gaining importance in herbal cosmetic products, particularly in anti-aging creams. Even though it is usually thrown away as waste, the peel contains a high amount of nutrients and active compounds that offer various benefits for the skin. Incorporating it into topical formulations provides a natural, affordable, and environmentally friendly option for skincare. Banana peel is the outer layer of the banana fruit and is recognized as a significant source of natural bioactive constituents. It is rich in antioxidants such as polyphenols, flavonoids, carotenoids, and essential vitamins including vitamin C and vitamin E. These components help safeguard the skin against oxidative stress and free radical damage, which are key factors responsible for early aging. Banana peel also provides strong moisturizing and nourishing effects that maintain skin hydration and enhance softness. It possesses mild anti-inflammatory properties that help calm irritated skin and reduce redness. Furthermore, it aids in skin regeneration and improves overall skin texture and elasticity. Because of these advantages, banana peel is extensively utilized in herbal and cosmetic products for anti-aging and skincare applications.

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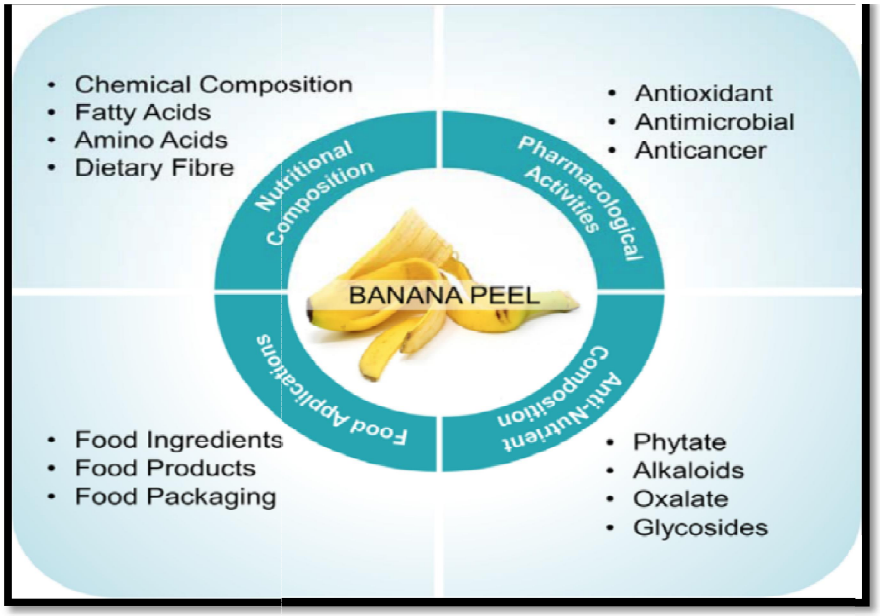

Fig.No.3

2. Pomegranate peel:

Pomegranate peel, obtained from Punica granatum, is an important natural material increasingly utilized in herbal anti-aging formulations. Despite commonly being treated as a waste product, the peel contains a rich concentration of bioactive substances that offer notable benefits for the skin, especially in delaying early signs of aging. Its strong antioxidant properties make it a highly effective ingredient in cosmetic preparations designed to enhance skin condition and overall appearance. Pomegranate peel is the external covering of the pomegranate fruit and is regarded as a valuable source of biologically active compounds. It is abundant in antioxidants including polyphenols, flavonoids, tannins, and ellagic acid. These constituents play an important role in protecting the skin from oxidative stress and damage caused by free radicals. The peel also demonstrates significant anti-inflammatory and antimicrobial effects, making it highly beneficial for cosmetic and skincare use. In addition, it aids in skin regeneration by supporting cell renewal and enhancing skin texture. Its ability to provide protection against UV radiation helps in reducing photoaging signs such as wrinkles and pigmentation. Hence, pomegranate peel is extensively incorporated in herbal cosmetic and anti-aging formulations.

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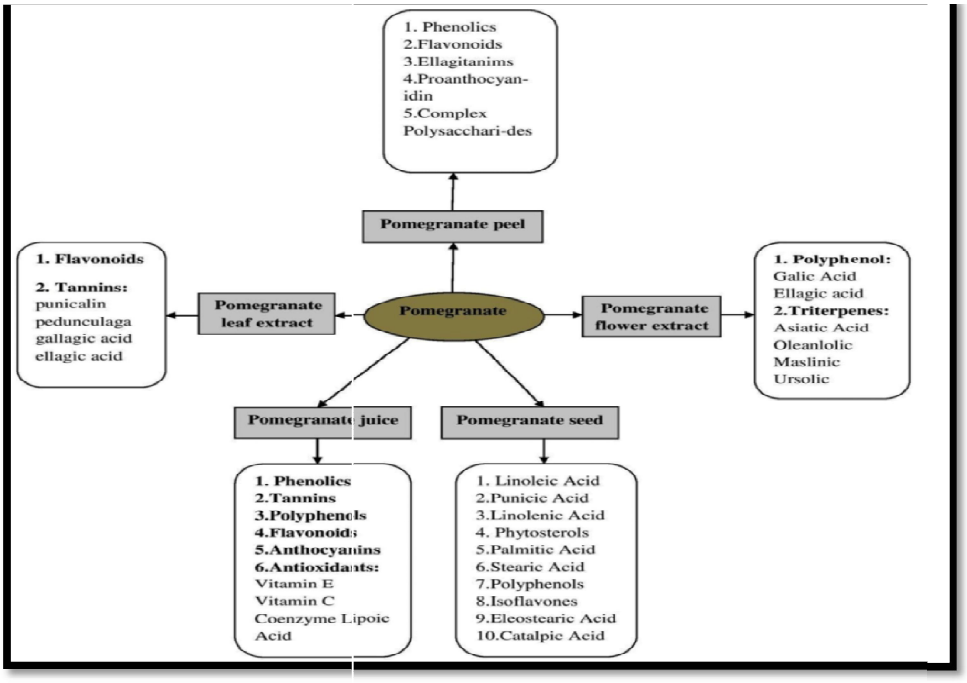

Fig. No.4

3. Aloe vera gel:

Aloe vera gel, derived from Aloe vera, is a commonly used natural component in herbal skincare products, particularly in anti-aging creams. It is well recognized for its calming, hydrating, and healing effects on the skin. Being rich in vitamins, enzymes, and various bioactive substances, it helps support skin health, promotes a youthful appearance, and is highly appreciated in cosmetic preparations. Aloe vera gel is a transparent, gel-like substance extracted from the inner pulp of Aloe vera leaves and is extensively utilized in skincare because of its strong therapeutic benefits. It contains a wide range of nutrients, including vitamins A, C, and E, as well as minerals, enzymes, amino acids, and polysaccharides. These active constituents provide potent antioxidant, anti-inflammatory, and moisturizing actions, which are highly beneficial for maintaining healthy skin. Aloe vera gel deeply hydrates the skin while remaining non-greasy, making it suitable for all skin types. It is particularly valued for its soothing properties, as it helps reduce irritation, redness, sunburn, and inflammation caused by environmental exposure. Moreover, it supports skin repair and regeneration by enhancing fibroblast activity and boosting collagen synthesis, thereby improving skin elasticity and reducing visible signs of aging. Owing to these advantages, aloe vera gel is commonly incorporated into herbal cosmetic and anti-aging formulations as a natural moisturizer and skin protectant.

V. PREPARATION OF EXTRACT

Peel of Musa paradisiaca bananas and peel of Punica granatum pomegranates are frequently utilized for extract production in anti-aging products. The peels are initially gathered and properly cleaned to eliminate dirt and contaminants. They are subsequently chopped into smaller sections to allow for even drying. The items are dehydrated in the shade or in a hot air oven until all moisture is eliminated. Once dried, the peels are milled into a fine powder with a grinder.The powdered substance is immersed in an appropriate solvent like ethanol or a hydroalcoholic solution. The combination is maintained for 24–72 hours with regular stirring to guarantee effective extraction of bioactive substances. The liquid is separated from the solid residue by filtering the extract. The solvent is evaporated using a

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water bath or evaporator to concentrate the filtrate. The ultimate extract is kept in a sealed container for future use in formulating anti-aging cream.

Preparation of Cream Formulation:

The cream is created by initially dividing the formulation into two components: the oil phase and the water phase. The oil phase, made up of components like stearic acid, cetyl alcohol, and oils, is warmed to an appropriate temperature until it is thoroughly melted. Simultaneously, the water phase comprising water, plant extracts, and humectants such as glycerin is heated independently to the same temperature. The warm aqueous phase is gradually introduced to the oil phase while stirring continuously to create an emulsion. The blend is mixed thoroughly to achieve a smooth and consistent cream. Subsequently, the mixture is permitted to cool slowly, after which heat-sensitive components like preservatives, fragrances, or active ingredients are incorporated. Ultimately, the prepared cream is placed into suitable containers and kept under proper conditions.

VI. EVALUATION OF PREPARED CREAM FORMULATIONS

1. Organoleptic Evaluation:

The organoleptic evaluation test is carried out to examine the sensory attributes of a cream using human senses such as vision, smell, and touch. It evaluates characteristics including color, fragrance, texture, consistency, and overall appearance of the formulation. This test is useful in judging the cosmetic appeal and acceptance of the product by users. A properly formulated cream should exhibit a uniform color, pleasant smell, smooth texture, and consistent structure without lumps or phase separation. The fragrance should be agreeable and free from any unpleasant or harsh odor. The texture should feel soft, non-greasy, and easy to spread on the skin. This evaluation is important as sensory qualities greatly influence customer satisfaction and the market success of cosmetic formulations.

2. pH Determination:

pH determination is a key factor in the evaluation of creams. It ensures that the formulation is suitable and compatible with human skin. The normal pH of skin lies between 4.5 and 6.5. If the pH becomes too acidic or too alkaline, it can lead to irritation or dryness. Maintaining an appropriate pH supports the natural protective barrier of the skin. It also contributes to better stability of the formulation. Therefore, correct pH is essential for the safety and effectiveness of the cream.

3. Viscosity:

Viscosity is the measure of a cream's thickness or its resistance to flowing. It describes the way the formulation behaves when it is applied to the skin. A higher viscosity indicates a thicker consistency, whereas a lower viscosity means a more liquid form. It has a direct influence on how easily the cream spreads and is absorbed by the skin. An appropriate viscosity ensures easy and smooth application without running or dripping. It also reflects the physical stability of the formulation. Therefore, viscosity plays an important role in product quality and user satisfaction.

4. Spreadability:

Spreadability refers to the ease with which a cream can be applied over the skin. It indicates how uniformly the formulation can be distributed on the surface. Good spreadability allows the cream to cover the skin evenly. It also minimizes the effort required during application. It enhances the absorption of active components into the skin. Inadequate spreadability may result in irregular or patchy application. Hence, it is an important parameter for assessing cosmetic quality.

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5. Homogeneity:

The homogeneity test is performed to confirm that all ingredients in the cream are evenly and properly mixed throughout the formulation. It verifies that both active and inactive components are uniformly dispersed without any formation of lumps, particles, or phase separation. A well-homogenized cream ensures a consistent texture, appearance, and performance across the entire product. During testing, the formulation is observed visually and may also be checked under magnification to identify any inconsistencies. Good homogeneity enhances the stability and overall quality of the cream. It also guarantees uniform application and effective distribution of active ingredients on the skin. Therefore, this test is important for assuring the quality of the final product.

6. Skin Irritation Test:

This test is used to determine whether the cream produces any adverse skin reactions. It is commonly conducted on human volunteers or, where permitted, on animals following ethical guidelines. The test monitors for signs such as redness, itching, or swelling after application. A well-formulated cream should not trigger any form of irritation. It is an important step to confirm the safety of the product for external use. Herbal formulations are usually associated with a lower risk of irritation. Hence, this test helps in establishing the dermatological safety of the cream.

7. Washability:

The washability test is conducted to assess how readily a cream can be cleaned off from the skin using water. It is used to evaluate the cleansing properties and ease of use of the formulation. An ideal cream should be easily removable without leaving behind any oily or sticky layer on the skin. In this test, a small amount of cream is applied to the skin or a test surface and then rinsed with water to observe how effectively it is removed. Quick and complete removal indicates good washability. If the cream is difficult to wash off, it may contain excess oil or have formulation issues. This test is important to ensure user comfort and prevent residue accumulation on the skin.

8. Microbial Limit Test:

The microbial limit test is conducted to evaluate the presence and quantity of microorganisms in a cream or cosmetic product. It confirms whether the formulation is free from harmful bacteria, fungi, and other microbial contamination. This test is crucial, as contaminated products may lead to skin infections, irritation, and other health-related problems. In this procedure, samples of the cream are inoculated on suitable culture media and incubated under controlled conditions to detect microbial growth. The total number of viable bacteria and fungi is then counted and compared with standard permissible limits. An ideal formulation should exhibit little to no microbial growth, indicating good preservation and hygienic manufacturing practices. This test ensures the safety, quality, and shelf stability of the final product.

9. Stability Studies:

Stability studies are performed to assess the behavior of a cream over time under varying environmental conditions. This test confirms that the formulation retains its physical, chemical, and microbiological characteristics throughout its intended shelf life. The product is subjected to different conditions such as changes in temperature, humidity, and light exposure to detect any possible alterations. Important parameters like color, odor, texture, pH, viscosity, and phase separation are continuously observed during the study. A stable formulation should show no significant deterioration or separation over time. This evaluation also helps in determining suitable storage conditions for maintaining product quality. Thus, stability testing is crucial to ensure the safety, efficacy, and long-term stability of the cream.

10. Phase separation test:

This test is carried out to examine whether the oil and water phases of a cream separate over time. A well-stable formulation should remain consistently blended without any separation. If separation occurs, it suggests poor

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formulation quality or instability of the product. Such instability can negatively affect both the appearance and performance of the cream. It may result from inadequate or improper emulsification during preparation. The use of suitable emulsifying agents helps in maintaining a stable mixture. Therefore, this test is important for confirming the overall stability of the formulation.

Advantages:

1. High antioxidant capacity: Contains abundant polyphenols, flavonoids, and vitamins that defend the skin against free radical damage.
2. Delays visible aging: Effectively reduces wrinkles, fine lines, and skin sagging.
3. Strengthens collagen structure: Helps maintain collagen levels and improves skin firmness.
4. Improves skin elasticity: Makes the skin more firm, smooth, and youthful in appearance.
5. Excellent moisturizing ability: Banana peel aids in retaining moisture and prevents skin dryness.
6. Powerful anti-inflammatory effect: Pomegranate peel helps reduce redness, irritation, and inflammation.
7. UV protection (photoprotection): Shields the skin from ultraviolet damage and reduces photoaging.

Disadvantages:

1. Delayed effectiveness: Results are seen slowly compared to synthetic anti-aging formulations.
2. Inconsistent quality: The composition of natural extracts may change based on source and harvesting conditions.
3. Poor stability: Herbal components may break down more quickly over time.
4. Reduced shelf life: Natural products often require preservatives to extend usability.
5. Skin sensitivity risk: Some individuals may develop mild irritation or allergic responses.
6. Limited skin penetration: Active ingredients may not deeply absorb without special delivery systems.
7. No proper standardization: Maintaining uniform concentration of active compounds is difficult.

VII. CONCLUSION

Herbal anti-aging creams formulated using banana peel and pomegranate peel offer a natural and efficient method for maintaining youthful and healthy skin. These plant-derived materials are abundant in antioxidants, flavonoids, polyphenols, vitamins, and vital minerals that play a significant role in reducing oxidative stress, a primary factor responsible for skin aging. Through the neutralization of free radicals, they safeguard skin cells from damage and delay the appearance of wrinkles, fine lines, and skin sagging. This formulation also aids in preserving collagen levels and improving skin elasticity, resulting in a firmer, smoother, and more rejuvenated appearance. Banana peel provides excellent moisturizing and nourishing benefits that help maintain skin hydration and softness, while pomegranate peel delivers strong anti-inflammatory and UV-protective actions that shield the skin from environmental and solar damage. Furthermore, these herbal formulations support skin cell regeneration and enhance overall skin tone and radiance. The utilization of fruit peel extracts also promotes environmental sustainability by effectively transforming agricultural waste into valuable cosmetic resources. Despite certain drawbacks such as slower visible effects and stability challenges, these products remain safe, affordable, and suitable for regular use. In conclusion, banana peel and pomegranate peel-based anti-aging creams serve as a highly promising, sustainable, and effective alternative to conventional synthetic skincare products.

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IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 8, May 2026
Impact Factor: 8.2

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