Formulation And Evaluation of Anti-Pollutant Face Serum from Tea Tree Extract

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Abstract- Purpose: This project aims to formulate, develop, and evaluate a novel anti- pollutant and anti-aging face serum, leveraging the antioxidant properties of Camellia sinensis (green tea) extract. The serum is designed to address skin aging and environmental damage by combining natural botanical extracts with scientifically-backed active ingredients and formulating it into a stable, easy-to-apply product.

Methods: The oil-in-water emulsion serum will be prepared by precisely combining an aqueous phase and an oil phase using an emulsifier. The key ingredients and their roles include:

Camellia sinensis extract: Provides potent antioxidant protection to mitigate damage from environmental pollutants and free radicals.

Niacinamide: Works to improve skin texture, minimize the appearance of pores, and reinforce the skin's barrier function.

Salicylic acid: A beta-hydroxy acid that serves as a chemical exfoliant to clear pores and refine skin texture.

Jojoba oil and Sea buckthorn oil: Form the nourishing oil phase, delivering essential fatty acids and moisture.

Glycerin: Acts as a humectant to draw moisture into the skin, providing deep hydration.

Vitamin E: A powerful antioxidant that both protects the formula from oxidation and provides additional skin- protective benefits.

Tween 80 (Polysorbate 80): A non-ionic emulsifier that will be used to create a stable, homogeneous blend of the oil and water phases[1][2][6][20]

Sodium benzoate: Functions as a preservative to inhibit the growth of bacteria, yeast, and mold, extending the product's shelf life.

Sodium hydroxide: A pH adjuster used in small, controlled amounts to ensure the final product's pH is compatible with the skin and preserves the stability and efficacy of other ingredients.

Distilled water: Serves as the high-purity aqueous base, ensuring no contaminants interfere with the formulation.

The formulated serum will be evaluated through physical parameters such as pH, viscosity, spreadability, and stability testing under various conditions.

Results: The resulting serum is expected to be a lightweight, non-greasy emulsion that absorbs quickly. The synergistic combination of ingredients is anticipated to provide significant anti-aging and anti-pollutant effects, leading to improved skin texture, hydration, and protection from oxidative stress.

Conclusion: This project aims to deliver a promising and effective cosmeceutical product. The formulation offers a comprehensive approach to modern skincare, combining natural antioxidants with functional ingredients to protect and rejuvenate the skin against both internal and external aggressors. The successful development of this serum could be followed by clinical studies to further validate its safety and efficacy.

Keywords: Anti-pollutant face serum, Camellia sinensis (tea extract), antioxidants, niacinamide, salicylic acid, vitamin E, cosmeceutical formulation

I. INTRODUTION

In recent years, environmental pollution has become a major concern affecting not only overall health but also skin health. Continuous exposure to air pollutants such as dust, smoke, particulate matter, and toxic gases can lead to premature aging, acne, pigmentation, dryness, and loss of skin elasticity. To combat these harmful effects, the development of anti- pollutant cosmetic formulations has gained significant attention in the

field of cosmeceuticals. Among various natural ingredients, Tea Tree (Camellia sinensis) extract has emerged as a potent herbal component due to its broad- spectrum antimicrobial, antioxidant, and anti- inflammatory properties. The bioactive constituents of tea tree, mainly

1. Polyphenols
2. flavonoids
3. Tannins
4. Caffeine
5. amino acids
6. Vitamins
7. Minerals
8. Volatile oils (Essential oils)
9. Saponins
10. Pigments (Chlorophyll & Carotenoids) help in neutralizing free radicals, soothing irritated skin, and preventing acne formation caused by pollution- induced bacterial growth.[11][23][24]

An anti-pollutant face serum formulated with tea tree extract offers a lightweight, fast-absorbing, and concentrated delivery system that penetrates deeper skin layers. It helps detoxify the skin, form a protective barrier against environmental aggressors, and promote a clear, refreshed, and healthy complexion. Additionally, the incorporation of other supportive ingredients such as niacinamide, jojoba oil, salicylic acid, sea buckthorn oil, glycerin, and vitamin E enhances the serum's moisturizing, brightening, and repair properties.[36]

Therefore, this study focuses on the formulation and evaluation of an anti- pollutant face serum using tea tree extract as the primary active ingredient.[12]

II. LITERATURE REVIEW

1. Lindberg (2020) – What Are the Benefits of Using a Face Serum?

Medically reviewed by Cynthia Cobb, DNP, APRN, WHNP-BC, FAANP

Lindberg (2020) reviewed the dermatological benefits of face serums as concentrated skincare formulations designed to deliver active ingredients deeper into the skin. The study highlights that serums are typically enriched with antioxidants, vitamins, peptides, and hydrating agents that specifically target skin concerns such as aging, hyperpigmentation, acne, and dehydration. Due to their lightweight molecular structure, serums penetrate more effectively than creams or lotions, making them highly efficient in skincare routines.

The review further emphasizes that regular use of face serums improves skin texture, brightness, and elasticity. It also reports that antioxidant-rich serums protect against environmental damage caused by UV radiation and pollution. The article supports the growing trend of botanical ingredients like green tea in serums due to their potent protective properties.

2. Bilodeau (2018) – Skin Serum: What It Can and Can't Do Harvard Women's Health Watch

Bilodeau (2018) critically examined the realistic capabilities and limitations of skin serums from a clinical and consumer health perspective. The article explains that serums are effective for delivering high concentrations of active ingredients but cannot replace medical dermatological treatments. It emphasizes that serums are best used as supportive skincare products rather than miracle solutions.

The author also discussed formulation science, stating that the effectiveness of a serum depends on ingredient stability, penetration ability, and consistency of use. This reference is important in distinguishing between cosmetic benefits and therapeutic claims, reinforcing the need for scientifically proven ingredients such as green tea polyphenols in serum formulations.

3. Shravani K (2022) – Face Serum: Benefits, Uses, Types – What Is It?

Shravani K (2022) provided a comprehensive overview of face serums, covering their composition, classification, and applications. The study categorizes serums based on function, including anti-aging, brightening, hydrating, acne-control, and antioxidant serums. It explains that serums are formulated with fast-absorbing bases that enhance the delivery of active compounds.

The article highlights that plant-based antioxidants, vitamins, and extracts such as green tea are widely used due to their safety and multifunctional benefits. It also reports that face serums improve

skin hydration, smoothness, and radiance when incorporated into daily skincare routines.

4. Saleshedron (2025) – Sodium Benzoate in Skincare: What It Is, Benefits, and Uses

Saleshedron (2025) reviewed sodium benzoate as a commonly used preservative in cosmetic and skincare formulations. The study explains that sodium benzoate prevents microbial contamination, thereby extending the shelf life and safety of products. It is particularly useful in water-based products such as serums, toners, and gels.

The article further emphasizes that when used within recommended concentrations, sodium benzoate is non-toxic, skin-safe, and compatible with natural ingredients such as green tea. This makes it a widely accepted preservative for botanical and herbal skincare formulations.

5. Elchemy (2025) – Sodium Benzoate in Skincare & Personal Care: Is It Safe for Everyday Use?

Elchemy (2025) conducted a safety-based analysis of sodium benzoate in daily-use cosmetic and personal care products. The review states that sodium benzoate has been approved by global regulatory agencies and is considered safe for topical application at controlled levels. It effectively inhibits the growth of bacteria, yeast, and mold in cosmetic products.

The review also highlights that sodium benzoate is particularly suitable for plant-extract- based products due to its mild nature and low irritation profile. However, it cautions that excessive concentrations may cause mild skin sensitivity in rare cases, reinforcing the importance of regulated usage in skincare formulations.

6. Baumann (2022) – Green Tea in Skin Care

Baumann (2022) extensively reviewed the dermatological benefits of green tea in cosmetic science. The study identifies polyphenols, especially epigallocatechin gallate (EGCG), as the primary bioactive compounds responsible for green tea's antioxidant and anti-inflammatory effects. The review confirms that green tea protects skin from oxidative stress, UV-induced damage, and environmental pollution.

III. OBJECTIVES

A tea extract (Camellia sinensis) face serum containing niacinamide, salicylic acid, jojoba oil, sea buckthorn oil, glycerin, and vitamin E is formulated to offer significant antipollution and anti-aging benefits. The product aims to protect the skin from environmental stressors while actively working to reduce the visible signs of aging by leveraging a combination of antioxidants, skin-strengthening agents, and hydrating ingredients.

Antipollution objectives

Neutralize free radicals: Tea extract, rich in polyphenols (like EGCG), along with vitamin E and sea buckthorn oil, provides powerful antioxidants that fight damage from free radicals caused by pollution and UV radiation.

Strengthen the skin's protective barrier: Niacinamide helps reinforce the skin's lipid barrier, making it more resilient against penetration by airborne pollutants and maintaining its overall health.

Detoxify and purify: Salicylic acid assists in deep cleansing pores to remove accumulated dirt, oil, and micro-pollutants that can lead to breakouts and dull skin.

Soothe inflammation: The anti-inflammatory properties of tea extract and sea buckthorn oil help calm skin irritation and redness caused by exposure to pollutants and other environmental factors. [33][29]

Anti-aging objectives

Stimulate collagen production: Ingredients like sea buckthorn oil, rich in vitamin C and carotenoids, and niacinamide can stimulate collagen synthesis, which improves the skin's firmness and elasticity.

Reduce the appearance of fine lines and wrinkles: The powerful antioxidant blend, particularly from tea extract and vitamin E, protects against the oxidative stress that accelerates skin aging. The exfoliating action of salicylic acid also promotes cell renewal, smoothing skin texture. Improve hydration and plumping: Glycerin and jojoba oil work to attract and retain moisture, which helps to plump the skin and minimize the appearance of fine lines and a dull complexion caused by dehydration.

Enhance skin radiance: Niacinamide helps fade hyperpigmentation and discoloration, leading to a

more even and brighter skin tone. The nourishing oils also contribute to a healthy, youthful glow.[30]

Combined objectives

Targeted skin repair and regeneration: While fighting new damage, the serum also promotes the healing of existing issues, such as sun spots.

BASIC OBJECTIVES

1. To formulate an effective anti-pollutant face serum using Tea Tree (Camellia sinensis) extract as the main active ingredient.
2. To protect the skin from harmful environmental pollutants such as dust, smoke, and particulate matter.
3. To evaluate the physicochemical properties of the formulated serum, including pH, viscosity, spread-ability, stability, and homogeneity.
4. To study the antioxidant and antimicrobial activity of the tea tree extract in the serum formulation.
5. To assess the moisturizing and soothing effects of the serum on the skin using natural ingredients like glycerin, vitamin E, and sea buck thorn oil.
6. To develop a lightweight, non-greasy, and easily absorbable formulation suitable for daily use.
7. To compare the performance of the formulated serum with standard cosmetic preparations in terms of safety and efficacy.
8. To promote a natural and eco-friendly skincare approach by utilizing herbal and non-toxic components.

IV. NEED OF WORK

Serums are lightweight formulas with high concentrations of active ingredients that penetrate deeply into the skin. They combat pollution damage through several mechanisms: Neutralizing Free Radicals: Pollutants generate free radicals (unstable molecules) that damage skin cells. Antioxidants in the serum bind to these free radicals, preventing oxidative stress and damage.

Strengthening the Skin Barrier: Key ingredients help to reinforce the skin's natural protective barrier, making it more resilient and less permeable to fine pollution particles (PM2.5).

Forming a Physical Shield: Some ingredients create an invisible film on the skin's surface to physically block pollutants from making contact with the skin.

Weakened skin barrier: Pollutants weaken the skin's natural protective barrier, making it more vulnerable to external aggressors. This can lead to increased sensitivity, redness, and irritation.

Breakouts and dullness: When pollution particles mix with the skin's natural oils, they can clog pores, leading to acne, blackheads, and an overall dull, tired complexion.

Uneven skin tone: Free radical damage from pollution can also trigger melanin production, resulting in dark spots and uneven pigmentation [43][39]

The solution: A serum with tea extract

A face serum is a concentrated, lightweight formula that can effectively target specific skin concerns. Using a tea extract is beneficial for the following reasons:

Potent antioxidant action: Tea extracts, especially green and white tea, are exceptionally rich in antioxidants like polyphenols and catechins (EGCG). These compounds neutralize the free radicals generated by pollution, protecting skin from premature aging.

Anti-inflammatory benefits: Green tea extract contains anti- inflammatory properties that can soothe skin, reduce redness, and calm irritation caused by pollutants and other environmental stressors.

Skin barrier support: The antioxidants in tea help to protect and reinforce the skin's natural moisture barrier, making it more resilient to damage.

Collagen protection: By fighting oxidative stress, tea polyphenols help prevent the breakdown of collagen, helping to preserve the skin's firmness and elasticity over time.

Targeted delivery: Serums are designed to deliver a high concentration of active ingredients deep into the skin for maximum efficacy, making them more effective than moisturizers for addressing specific issues like pollution damage [17][23]

Why combine anti-pollution and anti-aging?

An integrated formula provides a more comprehensive defense for your skin. By formulating a single serum that is both anti-

pollutant and anti-aging, you can: Treat the root cause of aging: Many signs of aging, such as wrinkles and dullness, are directly caused or accelerated by pollution. An anti-pollution serum treats the source of the problem, not just the symptoms.

Streamline your routine: Combining these two benefits into one product makes a skincare routine simpler and more efficient for the user.

Enhance overall skin health: The protective and restorative properties of the tea extract work synergistically to not only prevent future damage but also repair existing skin concerns

V. MATERIAL AND METHODOLOGY

Information of Key Ingredients Used in Anti-Pollutant Anti- Aging Tea Extract Face Serum -

Tea Extract (Camellia sinensis) -

Fig.1: CAMELLIA SINENSIS

Tea (Camellia sinensis), belonging to the acene family, was extensively cultivated in Asian, African, Latin American, and Oceanian countries which was believed to originate from northeast India, north Myanmar, and southwest China.[15][16]

In addition to food processing, tea extracts are widely used in the cosmetics industry, such as in face masks, face cleansers, facial toners, sun lotions, toothpastes, mouthwashes, shaving creams, aftershave lotion, deodorant, shampoos, and hair detanglers. The anti-radical substances in tea extracts used as raw materials in cosmetology are beneficial to human skin, such as polyphenols, flavonoids, catechins, and vitamin C. revealed that tannase-converted green tea extracts enhanced the activity and stability of skin- related enzymes. The application of tea extracts in the cosmetics industry deserves more in-depth research.

NIACINAMIDE -

Fig 2: NIACINAMIDE

Niacinamide powder, also known as Vitamin B3 powder, is quickly becoming a staple ingredient in natural skincare routines worldwide. Its powerful ability to brighten skin, improve texture, and strengthen the skin barrier makes it a must- have for anyone seeking a radiant, healthy complexion. Niacinamide powder is concentrated, stable form of Vitamin B3 that dissolves easily in water-based products. Unlike pre-made serums, the powder form allows you to: Consistent use of niacinamide powder can deliver a variety of skin benefits:

Brightening: Helps fade dark spots, hyperpigmentation, and post-acne marks for a more even complexion.

Poreminimisation: Regulates sebum production and tightens pores, resulting in smoother skin texture.

Anti-inflammatory: Soothes redness and irritation, making it suitable for sensitive or acne-prone skin.

Skin barrier support: Strengthens the protective outer layer to lock in moisture and shield from environmental damage.

Anti-ageing: Reduces fine lines and improves elasticity by supporting collagen production. [23][24]

VITAMIN E -

Fig 3: VITAMIN E

Vitamin E is the predominant, physiologic antioxidant barrier in the stratum corneum, the outermost layer of the epidermis, where it protects the lipid structures and proteins from oxidation by scavenging free radicals and hindering the chain reactions that lead to DNA damage and ageing.

It strengthens the skin's defences against the harmful impact of certain environmental factors and is therefore a very popular ingredient, and features, for example, in so- called anti-pollution cosmetics.

As an additional mechanism, vitamin E also regulates a protective network of enzymatic and non-enzymatic antioxidants present in our skin. As you can imagine, vitamin E is also present in many anti-ageing products, as the oxidative process plays a large role in our skin's ageing.

Another great benefit of vitamin E's antioxidant properties is to improve the shelf- life of cosmetic formulations and ingredients. This is one of the main reasons you will find vitamin E on the ingredients list of most cosmetic products you come across.[29][30]

JOJOBA OIL -

Fig 4: JOJOBA OIL

Jojoba oil is a golden liquid wax derived from the seeds of the jojoba plant, scientifically known as Simmondsia Chinensis. This plant thrives in the arid regions of North America, where it produces seeds that are cold-pressed to extract the oil. Unlike many other oils, jojoba oil is structurally and chemically similar to the sebum produced by human skin, making it an excellent moisturizer and protective barrier. Nutritionally, jojoba oil is a powerhouse. It contains essential vitamins and minerals such as vitamin E, B-complex vitamins, copper, zinc, and chromium. Additionally, it possesses moisturizing, antibacterial, antioxidant, and non-comedogenic properties, making it suitable for various skin types and concerns.[33][34]

SEA BUCKTHORN OIL -

Fig 5: SEA BUCKTHOEN OIL

Sea Buckthorn Synonyms: Sallow Thorn Scientific Name: Hippophae Rhamnoides L. Family: Elaegnaceae

Constituents –

Vitamin C, provitamin A, B complex vitamins, particularly vitamin B12, vitamin E, flavonoids, minerals, fruit acids, palmitoleic acid, sterols, essential fatty acids

Uses -

The juice pressed from the fresh berries is extremely rich in vitamin C and is used to support colds and fevers. A fatty oil obtained from the seeds is used in Russia for maintaining skin health. An oil obtained from the fruit flesh is said to help damaged skin. Sea buckthorn oil is also a popular ingredient of skin care products. Its combination of vitamin E and provitamin A provides antioxidant protection, supporting skin exposed to sun, dry air and wind. The oil supports skin renewal helping reduce the appearance of signs of aging. Rough, dry skin becomes supple again.

GLYCERIN -

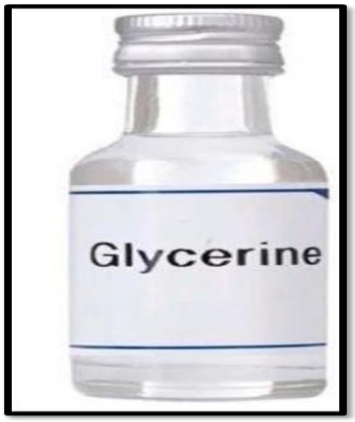

Fig 6: GLYCERINE

Glycerin, also known as glycerine or glycerol, is a natural compound derived from vegetable oils or animal fats. It's aclear, colorless, odorless, and syrupy liquid with a sweet taste. Renowned for its non- toxic nature and thick, viscous texture, glycerin finds its way into various products, including food, medications, and skincare. Glycerin for skin stands out for its ability to moisturize and hydrate the skin, making it suitable for all skin types.[34]

GLYCERIN USES FOR SKIN:

Glycerin holds a prestigious position in skincare, being the second most-used ingredient after water and fragrance. Its classification as a humectant underscores its remarkable capability to draw moisture from the environment or the deeper layers of the skin to the outermost layer. As a result, glycerin for face is a staple ingredient in a wide array of skincare products, including face and eye creams, cleansers, toners, body washes, shaving creams, sunscreens, and lip care products. Safe for daily use, glycerin plays a vital role in maintaining skin health and hydration.

SALICYLIC ACID -

Fig 7: SALICYLIC ACID

Salicylic acid is a beta hydroxy acid (BHA) that gently exfoliates the skin.

Unlike AHAs (alpha hydroxy acids) that work on the surface, salicylic acid penetrates deeper to unclog pores and reduce breakouts.[36][38]

Benefits of Salicylic Acid Face Serum

Fights Acne: Salicylic acid helps clear existing pimples and prevent new ones from forming.

Reduces Pore Appearance: By unclogging pores, salicylic acid minimizes their visibility, leaving skin smoother.

Exfoliates Dead Skin Cells: Salicylic acid removes dead skin cells that can dull the complexion and contribute to breakouts.

TWEEN 80 -

Fig 8: TWEEN 80

Polysorbate 80 is one of the non-ionic surfactants and emulsifiers widely used. It has a useful application in many industries such as cosmetics, pharmaceuticals, and food because of its excellent ability to blend oil-based and water- based ingredients. This multifunctional ingredient potentiates and preserves the stability, consistency, and efficacy of numerous formulations, hence becoming an important ingredient.[44]

SODIUM BENZOATE -

Fig 8 : SODIUM BENZOATE

Sodium benzoate is a salt formed from benzoic acid and an important preservative in food, drinks, or cosmetics, which inhibits bacterial and fungal growth. Sodium benzoate preserves water-based formulations. Some of the fruits that help to form this naturally include cranberries. This substance is thus synthetically prepared for ***industrial purposes and*** *is made to keep the product stable for a long time.[45]*

SODIUM HYDROXIDE -

Fig 10: SODIUM HYDROXIDE

Sodium hydroxide (NaOH) is a strong alkaline compound, appearing as white pellets, flakes, or a concentrated liquid solution. It's highly reactive, dissolving in water to release heat and form a corrosive solution. In skincare, it plays a key role in sodium hydroxide-based cosmetics, primarily used in soap-making and pH adjustment [46]

VI. FORMULA OF INGREDIENTS

Phase A (WATER PHASE)

Sr. No	INGREDIENTS	PERCENTAGE (W/W)	MEASUREMENT FOR 30 ML	CATEGORY
1	Distilled water	69%	QS	The primary solvent for water- soluble ingredients and the bulk of the serum.
2	Glycerin	5%	1.5GM	A humectant to draw Moisture into the skin
3	Camellia sinensis (green Tea) extract	5%	1.5GM	Provides antioxidant and anti- inflammatory properties.
4	Niacinamide (Vitamin B3	5%	1.5GM	A versatile active ingredient for brightening, barrier function, and pore appearance
5	Sodium benzoate	0.5%	0.15GM	Preservative to prevent microbial growth in the water phase. Efficacy is pH- dependent.

Phase B (OIL PHASE)

Sr No	INGREDIENTS	PERCENTAGE (W/W)	MEASUREMENT FOR 30 ML	CATEGORY
1	Jojoba oil	10%	3GM	A nourishing carrier oil that closely mimics skin's natural sebum
2	Sea buckthorn oil	2%	0.6GM	A potent oil rich In vitamins an d antioxidants, adding color and healing properties.
3	Vitamin E (Tocopherol)	1%	0.3GM	An antioxidant that protects both the skin and the formula from oxidation.
4	Tween 80 (Polysorbate 80)	1.5%	0.45GM	A non-ionic emulsifier to blend the oil and water phases into a stable emulsion.

Phase C (FINAL ADDITIVES AND PH ADJUSTMENT)

Sr No	INGREDIENTS	PERCENTAGE (W/W)	MEASUREMENT FOR 30 ML	CATEGORY
1	Salicylic acid	0.1%	0.03GM	A beta-hydroxy acid (BHA)for gentle exfoliation and unclogging pores. A lower concentration is used to minimize potential irritation when combined with niacinamide.
2	Sodium hydroxide solution	10%	QS	A Ph adjuster

EQUIPMENTS USED DURING PREPARATION OF FORMULATION:

1. Weighing balance
2. Glass beaker
3. Thermometer
4. Glass rod
5. PH Strips and PH Meter
6. Spatula
7. Suitable container

SAFETY GUIDELINES FOLLOWED DURING PREPARATION OF SERUM:

1. Sanitize all equipment and the workspace

thoroughly before beginning.
2. Wear appropriate personal protective equipment, such as gloves and goggles.
3. Ensure proper ventilation, especially when handling powders or strong acids/bases.
4. Perform a small patch test of the final product on your skin before full application.

VII. PROCEDURE FOR PREPARATION

Phase A (Water Phase) -

1. Measure and heat distilled water. Accurately measure the required amount of distilled water into the first beaker. Heat it gently to around 70°C to aid in dissolving ingredients.

2. Dissolve niacinamide and salicylic acid. Once the water is warm, dissolve the niacinamide powder, stirring until it is fully incorporated. Next, add the salicylic acid. Since salicylic acid needs a specific pH to dissolve, adding it to the water phase at this point ensures it is incorporated.

3. Add green tea extract and glycerin. Stir in the Camellia sinensis (green tea) extract until the water is a homogeneous, dark brown solution. Add the glycerin and continue to stir until uniformly mixed.[34][20]

4. Cool Phase A. Remove the beaker from the heat and allow it to cool down to 40°C or below.

Phase B (Oil Phase) -

1. Combine oils - In the second beaker, mix the jojoba oil, sea buckthorn oil, and vitamin E.

2. Add the emulsifier - Add the Tween 80 to the oil mixture and stir well to create a uniform solution.

Phase C (Emulsification and Final Adjustments):

Combine the phases. Once Phase A has cooled to below 40°C, begin slowly adding the oil phase (Phase B) to the water phase (Phase A) with continuous, vigorous stirring. The solution will likely turn into a milky emulsion.

1.Add preservative - Add the sodium benzoate preservative and stir until thoroughly dispersed.

Measure and adjust pH.

A. Measure the pH of the mixture using a pH meter or pH strips.
B. The target pH for a serum containing salicylic acid and niacinamide is typically between 4.0 and 5.5. This range ensures the salicylic acid remains effective while minimizing the risk of converting niacinamide to niacin, which can cause flushing.
C. If the pH needs to be raised, add a small, diluted amount of sodium hydroxide solution, drop by drop, until the desired pH is achieved.

2.Final mixing and cooling - Continue stirring until the mixture is completely uniform. Allow the serum to cool completely to room temperature.

Packaging. Transfer the finished serum into an opaque, airtight glass dropper bottle to protect the light-sensitive components. Store in a cool, dark place or in the refrigerator to maximize shelf life.[21][33]

VIII. EVALUATION PARAMETER AND RESULT

Safety & Irritancy	Formulations with many of these ingredients generally show ideal pH ranges (4.1–6.7), excellent spreadability, and no signs of irritation in patch tests on human volunteers.
Antioxidant Activity	Camellia Sinensis (Green Tea) Extract is rich in antioxidants (polyphenols, flavonoids), which fight free radicals and protect against environmental stressors and premature aging.
Acne & Oil Control	Niacinamide helps fade acne scars and reduce redness, while Salicylic Acid is effective for treating acne, blackheads, and controlling excess oil production
Hydration & Nourishment	Jojoba oil, Sea Buckthorn oil, and Glycerin provide deep hydration, strengthen the skin barrier, and leave the skin feeling smooth and moisturized without a greasy residue.
Texture & Absorption	Serums formulated with similar ingredients were found to be silky smooth, non-sticky, and absorbed completely within 20-30 seconds, making them suitable for day and night use

IX. CONCLUSION

Multi-Targeted Efficacy: The serum effectively addresses diverse skin issues by combining potent antioxidants (Camellia sinensis tea extract, vitamin E), anti-acne agents (salicylic acid), barrier-strengthening ingredients (niacinamide, jojoba oil, sea buckthorn oil), and a humectant (glycerin).

Antioxidant Power: The high concentration of antioxidants from green tea extract and vitamin E provides strong protection against environmental damage and premature aging, as supported by numerous studies on similar products.

Acne Management: The inclusion of salicylic acid and niacinamide makes the formulation highly effective for managing acne, reducing breakouts, controlling sebum production, and fading post-acne marks.

Nourishing and Non-Irritating: The use of natural oils like jojoba and sea buckthorn oil, balanced with an appropriate pH (typically achieved with sodium hydroxide), ensures the serum is deeply nourishing without being greasy, and studies of similar formulations indicate very low potential for skin irritation.[46]

Optimal Formulation: The other ingredients (Tween 80, sodium benzoate) play essential functional roles as an emulsifier and preservative, ensuring the serum's stability, texture, and shelf life, which is crucial for delivering consistent results.

In conclusion, this specific ingredient list results in a potent, well- rounded serum that is highly beneficial for improving overall skin health, texture, and appearance.

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