

FORMULATION AND EVALUATION OF A NOVEL HERBAL FACE TONER INTEGRATING ARECANUT EXTRACT AND ALUM STONE FOR ENHANCED ASTRINGENT AND ANTI-ACNE PROPERTIES

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ABSTRACT

The increasing demand for natural and herbal cosmetic formulations has encouraged the development of plant-based skincare products with minimal side effects. The present study focuses on the formulation and evaluation of a novel herbal face toner incorporating Areca catechu extract and alum stone to enhance astringent and anti-acne properties. Arecanut extract was obtained using Soxhlet extraction with ethanol, followed by phytochemical screening and physicochemical evaluation. The toner formulation consisted of arecanut extract, alum solution, witch hazel extract, glycerin, phenoxyethanol, and distilled water. Preliminary phytochemical analysis confirmed the presence of flavonoids, phenols, and tannins responsible for antioxidant and antimicrobial activities. The formulated toner was evaluated for physical appearance, pH, viscosity, spreadability, homogeneity, antimicrobial activity, and antioxidant potential. The pH of formulations ranged from 4.24

to 4.39, which is suitable for skin application. Viscosity ranged between 2.1–2.7 cP, ensuring easy spreadability. Antimicrobial studies demonstrated inhibitory effects against *Bacillus subtilis*. The DPPH antioxidant assay showed significant radical scavenging activity with a maximum value of 77%. Stability studies revealed no significant changes in color,

consistency, or homogeneity over one month of storage. The results suggest that the developed herbal toner is stable, safe, and effective for topical use and may serve as a natural alternative to synthetic skincare formulations for acne management and skin tightening.

KEYWORDS: Areca catechu, Herbal toner, Alum stone, Antioxidant, Antimicrobial, Herbal cosmetics.

INTRODUCTION

Cosmetic products are preparations intended for application on various parts of the human body for the purpose of cleansing, beautifying, enhancing attractiveness, or modifying appearance. In recent years, the demand for herbal cosmetics has increased considerably due to their perceived safety, better compatibility with the skin, and reduced risk of adverse reactions compared with synthetic cosmetic ingredients. Medicinal plants provide a valuable and sustainable source of bioactive compounds that can be incorporated into natural skincare formulations.

Facial toners represent an important component of modern skincare regimens. They are typically used after cleansing to remove remaining impurities, restore the natural pH of the skin, and tighten skin pores. In addition to these traditional functions, contemporary toners are often considered cosmeceutical products because they provide multiple benefits such as hydration, antioxidant protection, and antimicrobial activity that contribute to improved skin health and appearance.

The skin is the largest organ of the human body and serves as a primary protective barrier against environmental pollutants, microorganisms, and chemical agents. Maintaining healthy skin requires appropriate cleansing, hydration, and protection from oxidative stress. Facial toners assist in maintaining skin balance by removing residual dirt and oil, controlling sebum secretion, and improving overall skin texture.^[1]

Interest in herbal cosmetic formulations has increased significantly in recent years due to growing concerns about the potential harmful effects of synthetic chemicals present in conventional cosmetic products. Herbal ingredients are known to possess diverse pharmacological properties including antioxidant, antimicrobial, anti-inflammatory, and soothing effects on the skin.^[2] These properties make plant-derived materials attractive candidates for the development of safe and effective cosmetic preparations.

Areca catechu L., commonly known as arecanut and belonging to the family Arecaceae, is widely cultivated in tropical regions. The seed contains several biologically active constituents such as alkaloids, polyphenols, flavonoids, and tannins. These phytochemicals are reported to possess antioxidant, antimicrobial, anti-inflammatory, and astringent activities, which may be beneficial in maintaining skin health and improving skin firmness. Alum, chemically known as potassium aluminum sulfate, is a naturally occurring mineral that has been traditionally used in dermatological and cosmetic preparations. It is well recognized for its astringent and antimicrobial properties. Alum helps tighten skin tissues, reduce excess oil secretion, and inhibit the growth of microorganisms associated with acne and other skin infections.^[4]

MATERIALS AND METHODS

Materials

All materials used in the preparation of the herbal facial toner were of analytical grade. The main ingredients included glycerin, phenoxyethanol, citric acid, witch hazel extract, lavender oil, alum (potassium aluminum sulfate), and the ethanolic extract of *Areca catechu*. Glycerin was used as a humectant to retain moisture and improve skin hydration. Phenoxyethanol acted as a preservative to prevent microbial contamination and enhance the shelf life of the formulation. Citric acid was incorporated as a pH-adjusting agent to maintain the formulation within the normal physiological pH range of the skin. Witch hazel extract was included for its soothing and mild astringent properties, which help in tightening skin pores. Lavender oil was added to provide a pleasant fragrance and mild antimicrobial activity. Alum was selected due to its strong astringent and antibacterial properties, which contribute to skin tightening and acne prevention.

Equipment

Various laboratory instruments were used during the preparation and evaluation of the formulation. A grinder was used for size reduction of the plant material. A hot air oven was used for drying the plant samples to remove moisture. Soxhlet extraction apparatus was used for the efficient extraction of phytoconstituents from the plant material using ethanol as the solvent. A digital pH meter was used to determine the pH of the formulations, while an Ostwald viscometer was employed to measure viscosity. An electronic weighing balance was used for accurate measurement of all ingredients. The use of these instruments ensured precision and reliability during the experimental procedure.

Collection and Authentication of Plant Material

The nuts of *Areca catechu* were collected from Koratty, Kerala, India. The plant material was authenticated by Dr. Amithabachan, Assistant Professor, MES Asmabi College, to confirm its botanical identity. Authentication of plant material is an important step in herbal research to ensure the correct species is used for formulation and to maintain the quality and reproducibility of the study.

Preparation of Arecanut Powder

The collected arecanuts were first cleaned thoroughly to remove dust, dirt, and other unwanted materials. The nuts were then cut into smaller pieces to facilitate uniform drying. The pieces were dried in a hot air oven to remove moisture content, which helps prevent microbial growth and degradation of phytoconstituents. After complete drying, the pieces were ground using a mechanical grinder to obtain a coarse powder. Powdering increases the surface area of the plant material, thereby improving the efficiency of solvent extraction.

Extraction of *Areca catechu*

The powdered plant material was subjected to extraction using ethanol as the solvent. Ethanol was selected because it is effective in extracting a wide range of bioactive compounds such as polyphenols, flavonoids, tannins, and alkaloids.

Soxhlet extraction was employed for the extraction process. In this method, the powdered plant material was placed inside a thimble, which was then loaded into the Soxhlet apparatus. Ethanol was added to a round-bottom flask connected to the apparatus and heated to its boiling point. The solvent vapors condensed and passed through the plant material repeatedly. This continuous cycle allowed efficient extraction of the phytochemicals present in the plant. The extraction process was carried out for approximately 4–8 hours until the solvent in the siphon tube became colorless, indicating complete extraction of the active compounds. The obtained extract was then filtered to remove insoluble residues. The filtrate was concentrated by evaporating excess solvent to obtain a semi-solid crude extract. The extract was stored in airtight containers under refrigerated conditions until further use in formulation.

Formulation of Herbal Face Toner

The herbal facial toner was prepared by incorporating the ethanolic extract of *Areca catechu* with suitable excipients. Accurately weighed quantities of glycerin, witch hazel extract, alum, citric acid, phenoxyethanol, and lavender oil were used in the formulation.

Initially, the extract was dissolved in a suitable amount of solvent, followed by the addition of glycerin and witch hazel extract with continuous stirring to obtain a uniform mixture. Alum was dissolved separately and then added gradually to the mixture. Citric acid was used to adjust the pH of the formulation to match the natural pH of the skin. Finally, phenoxyethanol and lavender oil were incorporated as preservative and fragrance components, respectively. The prepared toner solution was mixed thoroughly to ensure uniform distribution of ingredients and then stored in clean airtight containers for further evaluation.

Evaluation of the Formulation

Organoleptic Evaluation

The prepared formulations were evaluated for physical appearance including color, clarity, odor, and presence of any particulate matter. Organoleptic evaluation helps determine the aesthetic quality and consumer acceptability of cosmetic formulations.

Determination of pH

The pH of the prepared toner formulations was measured using a calibrated digital pH meter at room temperature. Maintaining the pH within the physiological range of skin (approximately 4.0–6.0) is essential to prevent irritation and maintain skin barrier function.

Determination of Viscosity

The viscosity of the formulations was measured using an Ostwald viscometer. The time required for the toner solution to flow between two fixed points of the viscometer was recorded. Viscosity measurement helps determine the flow behavior of the formulation and ensures that the toner remains suitable for topical application.

Homogeneity Test

The formulations were visually examined for uniformity and the absence of phase separation or sedimentation. A homogeneous formulation ensures proper distribution of active ingredients and stability during storage.

Spreadability Test

Spreadability was evaluated to determine how easily the toner spreads over the skin surface. A good spreadability indicates better application characteristics and improved user convenience.

Antioxidant Activity

The antioxidant activity of the *Areca catechu* extract was determined using the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging assay. In this method, different concentrations of the extract were mixed with DPPH solution and incubated for a specific time. The decrease in absorbance was measured using a spectrophotometer, and the percentage of radical scavenging activity was calculated. This test helps evaluate the ability of the extract to neutralize free radicals.

Antimicrobial Activity

The antimicrobial activity of the toner formulation was evaluated against selected microbial strains using standard microbiological methods such as the agar diffusion technique. The inhibition of microbial growth indicated the antimicrobial potential of the formulation.

Patch Test

A skin patch test was performed to evaluate the safety of the formulation. A small amount of the toner was applied to a limited area of skin and observed for signs of irritation such as redness, itching, or inflammation after a specific period. This test helps determine whether the formulation is safe for topical application.

RESULTS AND DISCUSSION

The present study focused on the formulation and evaluation of a herbal facial toner containing *Areca catechu* extract and alum. The prepared formulations were subjected to various physicochemical and biological evaluations such as organoleptic characteristics, pH determination, viscosity measurement, and antioxidant activity. The results obtained from these evaluations are discussed below.

1. Organoleptic Evaluation

Organoleptic properties play an important role in determining the consumer acceptability of cosmetic products. The prepared toner formulations were evaluated visually for color, odor, clarity, and homogeneity.

Table 1: Organoleptic Evaluation of Herbal Face Toner.

Parameter	Observation
Color	Light brown
Odor	Pleasant aromatic
Appearance	Clear liquid
Homogeneity	Uniform without phase separation

The prepared toner formulations exhibited a clear and homogeneous appearance, indicating proper mixing and solubility of all ingredients. The light brown color was mainly due to the presence of *Areca catechu* extract. The pleasant odor was imparted by lavender oil, which improves the sensory characteristics of the formulation. No precipitation or phase separation was observed during storage, suggesting that the formulation remained stable.

2. pH Determination

The pH of cosmetic formulations is an important parameter as it influences skin compatibility and product stability. The pH values of the toner formulations were measured using a digital pH meter.

Table 2: pH Values of Herbal Face Toner Formulations.

Formulation	pH
FT1	4.24
FT2	4.25
FT3	4.24
FT4	4.27
FT5	4.39
FT6	4.31

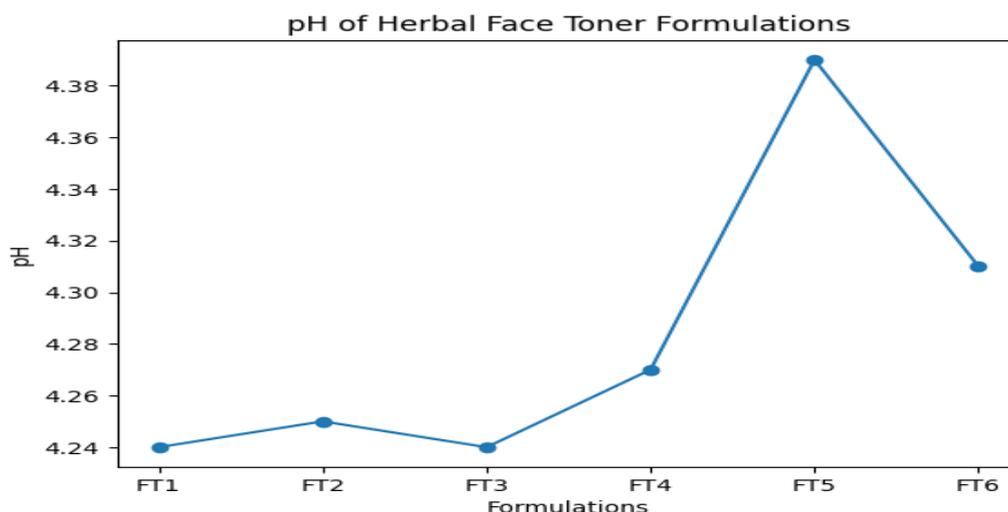


Figure 1: pH of Herbal Face Toner Formulations.

The pH values of the prepared toner formulations ranged from **4.24 to 4.39**. This range is considered suitable for topical cosmetic preparations because the normal pH of human skin lies between **4.0 and 6.0**. Maintaining the formulation within this range helps preserve the natural acid mantle of the skin and prevents irritation. The slightly acidic nature of the formulation may also contribute to antimicrobial activity and improved skin barrier function.

3. Viscosity Determination

Viscosity is an important physical property that determines the flow behavior and ease of application of topical formulations.

Table 3: Viscosity of Herbal Face Toner Formulations.

Formulation	Viscosity (cP)
FT1	2.1
FT2	2.3
FT3	2.4
FT4	2.3
FT5	2.7
FT6	2.6

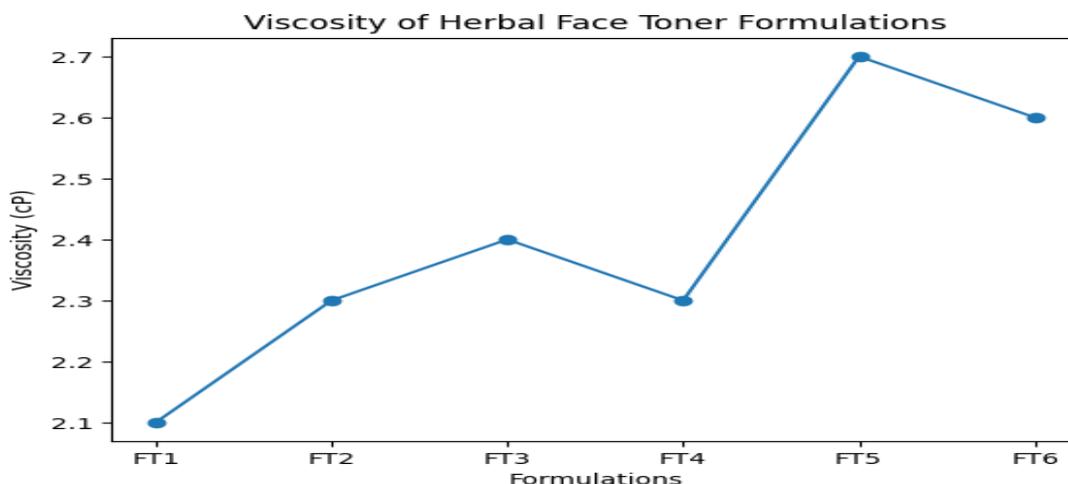


Figure 2: Viscosity of Herbal Face Toner Formulations.

The viscosity values of the prepared toner formulations ranged between **2.1 and 2.7 cP**. These values indicate that the formulation has a **low viscosity**, which is desirable for facial toner preparations. Low viscosity ensures that the toner spreads easily over the skin surface and can be applied using cotton pads or spray bottles. The slight variation in viscosity among formulations may be attributed to differences in the concentration of active ingredients and excipients used during formulation.

4. Antioxidant Activity (DPPH Assay)

The antioxidant activity of *Areca catechu* extract was evaluated using the DPPH radical scavenging assay. Antioxidants play a crucial role in protecting skin cells from oxidative damage caused by free radicals.

Table 4: DPPH Radical Scavenging Activity of *Areca catechu* Extract.

Concentration (µg/ml)	% Inhibition
1	6.6
2	11.30
3	74
4	77

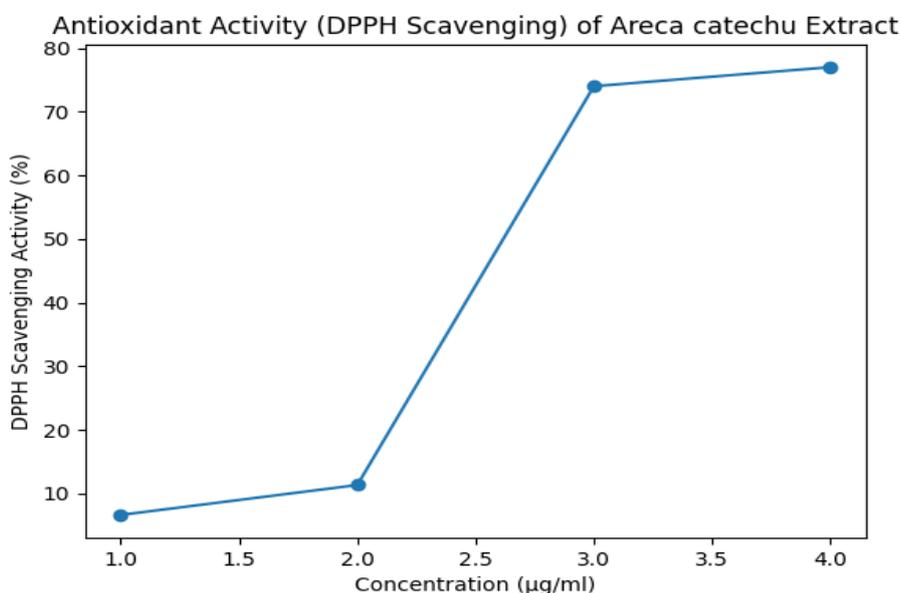


Figure 3: Antioxidant Activity of *Areca catechu* Extract.

The results showed that the antioxidant activity of *Areca catechu* extract increased with increasing concentration. The extract exhibited **maximum radical scavenging activity of 77% at the highest concentration tested**. This strong antioxidant potential can be attributed to the presence of bioactive phytochemicals such as **polyphenols, flavonoids, and tannins** in the arecanut extract.

Antioxidants are beneficial in skincare formulations because they help neutralize free radicals, which are responsible for premature aging, skin damage, and oxidative stress. Therefore, the inclusion of *Areca catechu* extract in the toner formulation may contribute to protecting the skin from environmental stress and improving overall skin health.

CONCLUSION

The present study successfully focused on the formulation and evaluation of a herbal facial toner containing *Areca catechu* extract and alum. The prepared formulations were evaluated for various physicochemical and biological parameters including organoleptic characteristics, pH, viscosity, and antioxidant activity. The results indicated that the developed toner exhibited suitable physical properties such as clear appearance, pleasant odor, and good homogeneity, which are important for consumer acceptability.

The pH of all formulations was found to be within the range of **4.24–4.39**, which is compatible with the normal physiological pH of human skin and helps maintain the natural skin barrier. The viscosity values ranged between **2.1 and 2.7 cP**, indicating that the formulation possessed an appropriate consistency for easy application and spreadability on the skin surface.

The antioxidant study using the DPPH radical scavenging method demonstrated significant antioxidant activity of the *Areca catechu* extract, showing up to **77% inhibition** at higher concentrations. This antioxidant potential may help protect the skin from oxidative stress and free radical damage.

The presence of alum in the formulation contributes to the astringent and antimicrobial properties of the toner, which may help in tightening skin pores and controlling microbial growth associated with acne. Overall, the study suggests that the developed herbal facial toner containing *Areca catechu* extract and alum could serve as a promising natural cosmetic product with potential benefits for skin care. Further studies such as stability testing and clinical evaluation may be conducted to confirm its long-term effectiveness and safety.

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Conflict of Interest

The authors declare that there is **no conflict of interest** regarding the publication of this research work.

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