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FORMULATION AND EVALUATION OF HERBAL ANTI-ACNE SERUM

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ABSTRACT

The serum is a concentrated product in cosmetics that nourishes the skin's interior layers without leaving an oily afterglow. The inflammatory skin condition called acne affects the sebaceous glands, which supply the hair follicles with fine hair. Acne lesions have been reported to include bacteria, such as Propionibacterium acne, Staphylococcus aureus, and Staphylococcus epidermis. One treatment for acne is to administer an antimicrobial. Neem extract has antibacterial and anti-inflammatory effects, which make it worthwhile for acne treatment and scar reduction. This study attempts to formulate and evaluate an herbal anti-acne face serum with extracts of neem leaves, aloe vera gel, sesame oil, almond oil, and sandalwood oil, taking into account the advantages of herbs in acne treatment. Five emulsion-type serum formulations were produced in this study by altering the concentration of neem extract (NE) and salicylic acid (SA) with (F2, F3, F4) and without (F1, F5) to compare the antibacterial activity. Various factors, including physical characteristics, pH, homogeneity, washability, globule size and antibacterial effect, were assessed for the prepared serums. In comparison to other formulations, formulation F1(2% SA & 10% NE) demonstrated superior antibacterial activity based on the zone of inhibition (34±0.7 mm) against S. aureus. To treat acne vulgaris, the herbal formulation F2, which contains 15% NE and no synthetic antibacterial agent, SA, has a satisfactory antibacterial efficacy (30 ± 0.9 mm zone of inhibition) considered as optimized herbal formulation. Further studies need to be conducted to confirm the anti-acne effect of face serum clinically.

Key words: Face serum, acne, neem extract, antibacterial activity, zone of inhibition

INTRODUCTION

Serums are among the most concentrated cosmetic products in terms of active ingredient concentration, and they nourish the skin's deeper layers deeply without leaving an oily finish. Face serums can assist in enhancing the firmness and texture of the face. Oil based serum, Water based serum, Emulsion based serum and Gel based serums are the main types of serums. Different face serums are available for different uses, including anti-aging, skin-brightening, hydrating, free-radical fighting, sensitive and acne-prone skin, and reparative/texture improvement serums **[1]**.

Acne is the disorder that affects the sebaceous (oil) glands that connect to the hair follicles that hold fine hair. The four stages of acne development are as follows: the first is increased sebum production and altered lipid composition in the sebaceous gland at the base of hair follicles; this is followed by pore blockage and Propionibacterium acne colonization, which causes inflammation and pus formation. Propionibacterium acnes bacteria are said to be the primary source of inflammation associated with acne. Furthermore, it has been demonstrated that acne lesions contain bacteria like *Staphylococcus aureus* and *Staphylococcus epidermis*. Giving antibacterial is one step that can be taken to treat acne **[2]**.

There are two approaches to treating acne: systemic therapy, which uses hormones, zinc, and antibiotics, and topical treatment, which employs comedolytic medicines, antibiotics, and different anti-inflammatory drugs. Prolonged and excessive use of antibiotics has resulted in the bacteria that cause acne, P. acne, and S. epidermidis, becoming more resistant to the antibiotics used to treat acne **[3]**.

Essential oils and extracts from medicinal plants have been extensively studied as potential solutions to the issue of antibiotic resistance. Herbs have many uses and are safe and effective. For topical acne treatments, herbs, and naturally produced substances are less likely to cause adverse effects than synthetic medicines. Neem leaves are traditionally used in medicinal formulations for their anti-inflammatory, antioxidant, hepatoprotective, antibacterial, and other properties. Neem can minimize skin inflammation, heal wounds, promote the creation of collagen, lessen post-acne scars, and balance oil production. It functions as a natural substitute to repair the skin's tissue while lessening scarring and hyperpigmentation. Neem extract has antibacterial and anti-inflammatory qualities, which make it useful in face serum formulations for acne treatment and scar reduction **[4]**.

The purpose of this study was to develop an herbal acne serum employing various kinds of antibacterial plants. This study attempts to formulate and evaluate an herbal anti-acne face serum with extracts of neem leaves, aloe vera gel, sesame oil, almond oil, and sandalwood oil, taking into account the advantages of herbs in acne treatment.

Materials: Aloe Vera plant, Neem leaves collected from premises of Hi-Tech college of Pharmacy, suitable analytical grade salicylic acid, sandal wood oil, sesame oil, Almond oil, Vitamin E, glycerin, ethanol, tween 20 distilled water were used. The various materials used in formulation with their use given in **Table 1**.

MATERIALS AND METHODS

Table 1: List of ingredients used in serum formulation with their use.

S. No.	Ingredients	Uses
1.	Salicylic acid	As a keratolytic agent, it reduces sebum output in acne sufferers and is used to treat acne, blackheads, whiteheads, and pigmentation. Additionally, it has anti-aging properties, lessens oily skin, lowers inflammation, exfoliates skin, deeply penetrates pores, and removes sebum [5].
2.	Neem Extract	Used as an antioxidant, antiviral, antibacterial, and anti-inflammatory. Reduce post-acne scars, heal wounds, promote collagen synthesis, balance oil production, and lessen skin inflammation. In addition to healing the skin, it lessens scarring and hyperpigmentation [4]
3.	Alovera gel	Used to treat sunburn, small wounds, bug bites, acne, pimples, and other skin conditions. It also has anti-inflammatory, anti-bacterial, and anti-fungal properties and promotes wound healing. It is an excellent source of vitamins and minerals with significant moisturizing properties and anti-aging advantages to preserve skin that is young and healthy [6,7].
4.	Sesame oil	Enriched with vitamins B and E, which reduce scarring and soothe rashes on the skin. Additionally, it works wonders for skin ailments like redness, psoriasis, eczema, athlete's foot, and inflammation. Its inherent anti-tanning qualities make it a great shield against the sun's damaging rays [8,9].
5.	Almond oil	Enhances complexion and skin tone, soothes the skin, and treats small cuts and wounds [10].
6.	Sandalwood oil	Its antimicrobial properties target P acnes, Staphylococcus aureus, and Staphylococcus epidermidis. It evens skin tone, gives off fragrance, nourishes the skin, increases skin cell suppleness, and may help lessen the visibility of scars. It can reduce acne and pimples and sooth skin because of its anti-inflammatory and skin-clearing qualities [11,12].
7.	Vitamin E	it has antioxidant, photoprotective, and skin barrier–stabilizing properties [13,14].
8.	Glycerin	it acts as a humectant. It can increase skin hydration, relieve dryness, and refresh the skin's surface, ability to attract and hold water [15].
9	Ethanol	It gives mild cooling sensation when apply externally on the skin or face. It allows serums to penetrate the skin quickly and easily [16].
10	Distilled Water	Aqueous phase vehicle and for hydration of skin.
11	Tween 20	Emulsifying agent.

Methods:

Aloe Vera gel collection:

Aloe Vera plant was collected from the herbal garden of Hi Tech College of pharmacy and identified. Aloe vera gel was collected, homogenized at 1200 rpm under mechanical homogenizer. The Homogenized gel was further filtered with a vacuum filter to get a clear and transparent gel **[17]**.

Neem leaves extraction:

The neem leaves were collected from the herbal garden of Hi Tech College of pharmacy, identified and washed with sterile

distilled water to remove a dust and debris. The extraction process is represented in **Figure 1 [18, 19]**.

Preparation of Serum:

Emulsion type serums (o/w) were prepared as per the formula given below **Table 2**. Oily phase triturated together till 10 minutes to get a homogenous solution. At the same time aqueous phase was prepared and the salicylic acid dissolved in ethanol and added to aqueous phase for F1, F5 formulations. The oily phase was added to aqueous phase drop by drop under mechanical stirring at 2500 rpm to get a oil in water based biphasic emulsion. The method of preparation of serum is illustrated in **Figure 2 [17, 20, 21]**.

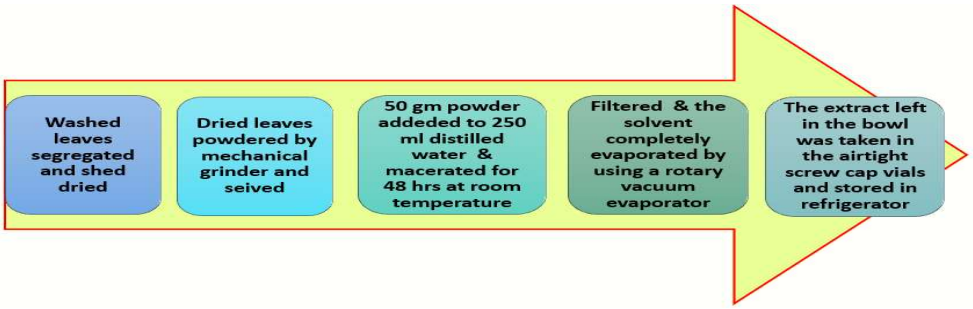

Figure 1: Aqueous extraction process of neem leaves

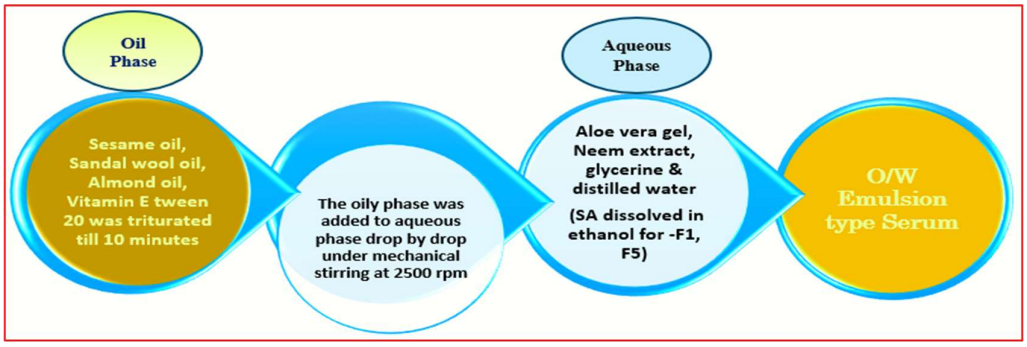

Figure 2: Method of preparation of emulsion type serum.

Table 2: Anti acne Face serum formulations

S. No.	Ingredients	F1	F2	F3	F4	F5
1	Salicylic acid	2%	-	-	-	2%
2	Ethanol	1 %	1 %	1 %	1 %	1 %
3	Aloe vera gel	25%	25%	25%	25%	25%
4	Neem Extract	10%	15%	10%	5%	-
5	Sesame oil	5 %	5 %	5 %	5 %	5 %
6	Almond oil	5 %	5 %	5 %	5 %	5 %
7	Sandal wood oil	1%	1%	1%	1%	1%
8	Glycerine	25%	25%	25%	25%	25%
9	Vitamin E	1 %	1 %	1 %	1 %	1 %
10	Tween 20	1 %	1 %	1 %	1 %	1 %
11	Distilled water	q.s	q.s	q.s	q.s	q.s

Evaluation of face serums [17, 21-23]

The prepared serums were evaluated for various parameters; the list of parameters and methods with required specifications is given in **Table 3**.

Table 3: Evaluation tests of anti-acne serum formulations

S. No.	Test	Procedure / Method	Required results / Specifications
1	Colour & Odour Appearance	Observed Visually	Good appearance and an attractive fragrance.
2	Homogeneity &Texure	Feel some formulation sample on the skin	Free from particulate matter with smooth homogeneous texture and non-greasy finish
3	pH of serum	Checked with pH meter	skin has an acidic range and the pH of the skin serum should be in the range of 4.1-6.7.
4	Washability	Checked by cleaning the area where the serum formulation was applied	Easily washable.
5	Globule size determination	analyzed under microscope	It should have a small globule size range for easy absorption into the skin.
6	Viscosity	Determined by Oswald viscometer	It should have optimal viscosity to make it easier to remove from the container and spread on the skin and enough to prevent the creaming of the emulsion.
7	Antimicrobial activity	Agar well diffusion method	Should Prevent microbial growth

Antimicrobial activity of face serum- [24]

The bacterial efficacy of prepared serum was tested using the agar-well diffusion method. Staphylococcus aureus bacterial isolates were inoculated in agar medium and poured into plates. Using a micropipette, serum samples were loaded into wells above the agar bed. After a 24-hour incubation period at 37°C, the various values of the inhibition zone (in mm) were recorded and evaluated.

RESULTS AND DISCUSSION

Fresh Alvera gel was collected and the neem extracted was obtained from dried neem leaf powder, the extract is brown in colour **(Figure 3)**.

Five serum formulations were prepared and evaluated. The appearance of F1 to F4 preparations is light brown **(Figure 4)**, and the F5 formulation is light cream. All formulations have the following characteristics: odour, smooth texture, good homogeneity, being easily spreadable, and being washable.

The formulations' pH values were discovered to fall between 4.5 and 6.2. This pH range is appropriate since the skin has an acidic pH of 4.1–6.7. The stability of emulsions is influenced by the size and distribution of globules, which also affects other aspects of the product's quality and performance, including spreadability, skin feel, adherence, homogeneity, texture, rheology, drug release, and skin penetration. It was found that the globule size ranged from 1µm to 5µm. This size range strengthens the formulation's said qualities.

Viscosity controls many properties, such as the substance's spreadability and pourability out of the container. The viscosity of the face serums was found to be 31.67 ± 4.01 to 37.19 ± 2.78 Cp, a key parameter for topical formulations, which is easily spreadable and pourable from the container.

The estimated evaluation parameters of all five formulations are mentioned in **Table 4**.

Antimicrobial activity

The results showed that all formulations had satisfactory inhibition of microbial growth. It was observed that the inhibition rate of the F1 formulation, which had both neem extract and salicylic acid, was more significant among all the samples, indicating the synergistic antibacterial effect of salicylic acid and neem extract. **Figure 5** shows the agar plates with a zone of inhibition of F1 to F5 formulations.

F2, F3, and F4 formulations (without salicylic acid) also showed a satisfactory zone of inhibition as they had the neem extract, sandalwood oil, and Alovera gel, which indicated these herbal extracts showed antibacterial effects as reported elsewhere. The formulation F5 without neem extract showed a zone of inhibition of 22 ±1.2 mm, less than the F2, F3, and F4 formulations, revealing that neem extract is as effective as salicylic acid because of its antibacterial effect. It was also observed that as the concentration of neem extract decreased from 15% to 5% (F2, F3, F4), the zone of inhibition also decreased, indicating the dose-dependent antibacterial effect of neem extract. **Figure 6** represents the comparison of the antibacterial activity of all five formulations.

Figure 3: Neem Extract

Figure 4: Anti acne herbal face serum

Table 4: Evaluation parameters of serum formulations

S. No	Evaluation parameter	Formulations				
		F1	F2	F3	F4	F5
1.	Physical Appearance					
	Colour	Light brown	Light brown	Light brown	Light brown	Light cream
	Odour	Characteristic	Characteristic	Characteristic	Characteristic	Characteristic
	Texture	Smooth	Smooth	Smooth	Smooth	Smooth
2.	pH	5.2	6.2	6	5.8	4.5
3.	Homogeneity	Good	Good	Good	Good	Good
4	Washability	Easily washable	Easily washable	Easily washable	Easily washable	Easily washable
5	Globule size	1-5 µm	1 – 5 µm	1 – 5 µm	1 – 5 µm	1 – 5 µm
6	Viscosity	35.15± 2.36	37.19 ± 2.78	35.59 ± 4.12	34.26 ± 3.45	31.67 ± 4.01
7	Zone of inhibition	34± 1.7 mm	30±1.9 mm	27± 0.8 mm	24± 1.3 mm	22 ±1.2 mm

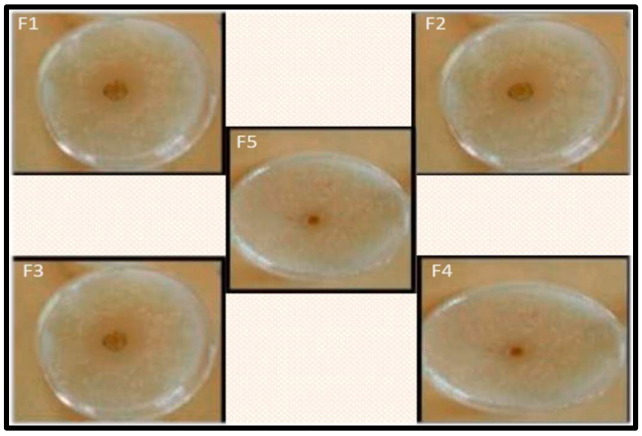

Figure 5: Zone of inhibition of F1 to F5 serum formulations

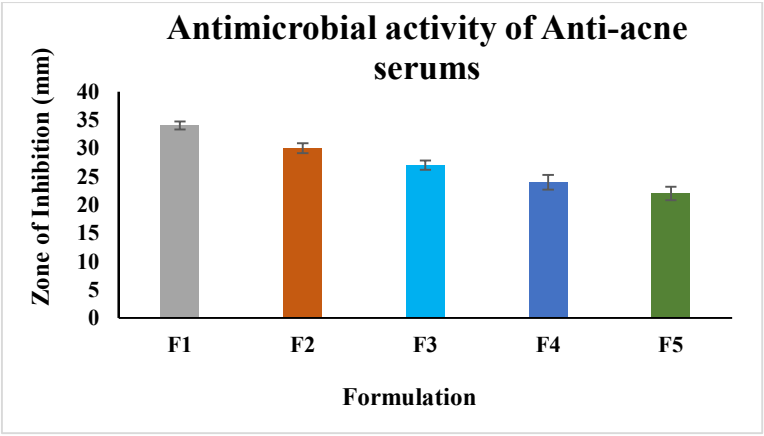

Figure 6: Comparison of antimicrobial activity of all formulations graphically

With this study, it is clear that a combination of the chemical antibacterial agent salicylic acid and herbal neem extract showed a synergistic antibacterial effect. Formulation F2, with the highest concentration of neem extract, also has satisfactory antibacterial properties, and the concentration of neem extract can be optimized further to get the desired antibacterial effect to treat acne.

CONCLUSION

Anti-acne face serum formulations F2, F3, and F4 were prepared by using herbal ingredients such as neem extract, almond oil, aloe vera gel, sandalwood oil, sesame oil, vitamin E, and F1, F5 formulations were prepared by including salicylic acid along with all ingredients to compare the activity of neem extract. The formulated face serums are evaluated by various evaluation parameters. Based on evaluation parameters, formulation F1 was more effective with its better antibacterial activity. With this study, it is clear that a combination of chemical antibacterial agents, salicylic acid, and herbal neem extract will be advisable for effective control of acne.

However, synthetic medications are no longer as popular for treating acne vulgaris as safe as all-natural treatments with fewer adverse effects. Consequently, in the global market sphere of nature, herbal medicines are sought after by many people. Herbs and naturally-derived compounds have fewer adverse effects than synthetic agents. So, formulation F2 with only herbal ingredients with a satisfactory antibacterial effect is efficacious in treating acne vulgaris. Further clinical studies need to be conducted to confirm the anti-acne effect of face serum. Optimization studies need to be conducted to optimize the concentrations of herbal ingredients.

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