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FORMULATION AND EVALUATION OF SYNDET BASED BABY SOAP

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ABSTRACT

Baby skin is delicate and more prone to dryness, irritation, and microbial infections due to its thinner stratum corneum, higher pH, and lower lipid content compared to adult skin. Conventional soaps may disrupt the natural skin barrier because of their alkaline nature. Therefore, the present study focuses on the formulation and evaluation of a mild, skin-friendly syndet-based baby soap incorporating natural and herbal ingredients such as calendula oil, neem oil, lavender oil, aloe vera gel, and vitamin E. The soap base was prepared using a saponification process followed by a melt-and-pour method to ensure uniform incorporation of active ingredients. Key components such as coconut oil, castor oil, stearic acid, glycerin, ethanol, and sugar were used to enhance lather, hardness, transparency, and skin hydration. The prepared formulations were evaluated for organoleptic and physicochemical parameters including color, odor, texture, pH, foamability, foam retention, hardness, and skin irritation. The results indicated that the developed syndet-based baby soap exhibited good physical characteristics, stable foam properties, and no signs of skin irritation, confirming its suitability and safety for baby skin.

KEYWORD: Baby soap, Syndet, Baby skincare, Herbal formulation, Mild cleanser.

INTRODUCTION

Skin care is an essential aspect of personal hygiene and overall well-being. The use of cleansing agents, such as soap and syndet bars, plays a vital role in maintaining healthy skin.[1]

Baby skin is structurally and functionally different from adult skin. It has a thinner stratum corneum, lower lipid content, and a higher pH, which makes it more vulnerable to irritation and dryness Therefore, special cleansing products are required to maintain skin hygiene without disturbing the natural moisture barrier. One of the most important things you can do to keep your baby healthy is to clean their skin with baby soap. Baby soaps are formulated to be mild and skin-friendly; however, they may still contain preservatives and other additives depending on formulation.[2]

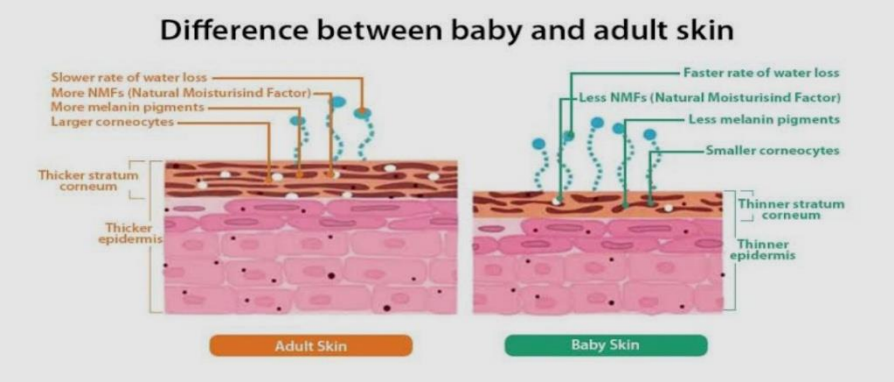

Fig. 1: Different between baby and adult skin.

Common skin problems in babies include

Dry and Rough Skin – Common in babies due to loss of moisture, frequent bathing, and use of harsh alkaline soaps.

Skin Irritation – Caused by synthetic chemicals, fragrances, or high pH products leading to redness and discomfort.

Rashes and Redness – Includes diaper rash and contact dermatitis due to allergens, microbes, or irritants.

Cracked or Peeling Skin – Occurs due to excessive dryness or environmental factors such as cold weather.

Microbial Infections – Bacterial or fungal infections may develop due to improper hygiene or compromised skin barrier.

To prevent these skin problems, various skincare products are available in the market, such as:

- Baby soaps
- Syndet bars
- Baby lotions
- Moisturizing creams
- Baby oils

Each of these products serves a specific purpose—cleansing, moisturizing, nourishing, and protecting the skin.

Traditional baby soaps, though widely used for cleansing, may sometimes have a more alkaline nature that can disturb the skin's natural pH. On the other hand, syndet bars are known for their mild and skin-friendly properties.[3] Similarly, baby lotions and moisturizing creams help in maintaining hydration, while baby oils provide nourishment and prevent moisture loss. The growing awareness toward gentle and safe skincare has led to the development of formulations that combine cleansing with moisturizing benefits.

Syndet based baby soap is an innovative category of cosmetic formulations that aim to formulate a mild and effective baby soap by incorporating the advantages of different baby care products.[3] The formulation includes natural oils and herbal ingredients such as neem, calendula, lavender, and aloe vera, which are known for their soothing, antimicrobial, and moisturizing properties.[16] The aim is to develop a soap which mimic the action of syndet and not only cleanses effectively but also helps in retaining skin moisture and protecting delicate baby skin.

The prepared formulation is evaluated for important parameters such as pH, foamability, hardness, and overall skin compatibility to ensure its safety and effectiveness for baby use. This study focuses on developing a gentle, multifunctional baby cleansing bar that supports healthy skin care.

By carefully selecting suitable oils and controlling the formulation conditions, a mild and skin-friendly soap base can be developed. In addition to the soap base, natural ingredients such as neem oil, calendula oil, aloe vera, lavender oil, and vitamin E are incorporated to

enhance the therapeutic effectiveness of the product. The combination of these ingredients helps in improving skin hydration, protection, and overall skin health of infants.[4]

Fig. 2: Baby Soap.

Aim: To formulate and evaluate a mild, skin-friendly syndet-based baby soap.

Objective: The objective of this study is to formulate a mild and skin-friendly syndet-based baby soap using natural ingredients such as neem, calendula, lavender, aloe vera, and vitamin E. Additionally, the prepared product is evaluated for parameters like pH, foamability, hardness, and skin compatibility to ensure its safety, effectiveness, and suitability for delicate baby skin.

MATERIALS AND METHODS

List of chemicals & reagents, Apparatus & Instrument

Sr. No	Ingredients	Instrument	Apparatus
1.	Calendula oil	Weighing balance	Beaker
2.	Neem oil	pH meter	Glass rod
3.	Lavender oil	Hot air oven	Tripod stand
4.	Aloevera gel		Burner
5.	Rose oil		
6.	Coconut oil		Measuring cylinder
7.	Stearic acid		Wire gauze
8.	Castor oil		China dish
9.	NaOH		Mould
10.	Glycerin		
11.	Ethanol		
12.	Sugar		
13.	Distilled Water		

Ingredients

Calendula

Calendula oil is obtained from the flowers of Calendula officinalis. It is widely known for its anti-inflammatory, soothing, and healing properties. It is commonly used in skincare products, especially for sensitive and baby skin.

Common Name: Pot Marigold

Botanical Name: Calendula officinalis

Family: Asteraceae

Origin: Mediterranean region

Plant Type: Herbaceous flowering plant

Chemical Constituents: Flavonoids, Triterpenoids, Carotenoids, Saponins[5]

Fig. 3: Calendula flower

Neem

Neem oil is extracted from the leaves of Azadirachta indica. It possesses strong antibacterial, antifungal, and anti-inflammatory properties and is widely used in medicinal and cosmetic preparations.

Common Name: Neem

Botanical Name: Azadirachta indica

Family: Meliaceae

Origin: Indian subcontinent

Chemical Constituents: azadirachtin, nimbin, nimbidin, nimbolide, and salannin[6]

Fig. 4: Neem.

Extraction (Neem Leaf Infused Oil)

Wash the neem leaves and let them dry completely (no moisture).

↓

Crush or grind the leaves slightly.

↓

Heat the carrier oil on low flame

↓

Add the leaves and simmer on very low heat for 20–30 minutes.

↓

Let it cool, then strain using a cloth or sieve.

↓

Store in a clean glass bottle.[7,8, 9]

Lavender

Lavender oil is an essential oil extracted from the flowers of Lavandula angustifolia. It has a pleasant fragrance and is known for its calming, antiseptic, and soothing properties.

Common Name: Lavender

Botanical Name: Lavandula angustifolia

Family: Lamiaceae

Plant Type: Aromatic shrub

Chemical Constituents: Linalool, Linalyl acetate, Terpenes, Flavonoids, Tannins.[10]

Fig. 5: Lavender.

Aloe vera

Aloe vera is a succulent plant species that has been used for centuries for its medicinal, cosmetic, and culinary purposes. The gel extracted from the leaves of the aloe vera plant is rich in vitamins, minerals, and antioxidants.

Common Name: Aloe vera

Botanical Name: Aloe barbadensis Miller

Family: Asphodelaceae

Chemical Constituents: Flavonoids, Triterpenoids, Carotenoids, Saponins, Aloin

Fig. 6: Aloe Vera Plant.

1. Soothes skin irritations: Aloe vera gel has anti-inflammatory and soothing propertiver

2. Hydrates the skin: Aloe vera gel is rich in vitamins A, C, and E which help to hydrate and nourish the skin.[11]

Vitamin E

Vitamin E is a natural antioxidant commonly added to baby soap to protect delicate skin and improve product stability. It helps moisturize and soothe the skin, reducing dryness and irritation. Additionally, it prevents oxidation of oils in the soap, thereby enhancing shelf life and maintaining quality.[12]

Fig. 7: Vitamin E Capsule.

Coconut oil (Cocos nucifera),

Derived from the meat of mature coconuts, has Emerged as a versatile and highly valued natural product with a wide array of applications. Renowned for its distinct aroma, creamy texture, and myriad health benefits, coconut oil has been Utilized for centuries across various cultures for culinary, medicinal, and cosmetic purposes.

Fig. 8: Coconut Oil.

Function:

Acts as a cleansing agent by removing dirt and oils

Produces good foam and lather

Gives hardness to the soap

Provides mild antimicrobial effect

Stearic Acid

Stearic acid is a saturated fatty acid commonly used in soap and cosmetic formulations. It acts as a hardening agent and helps in improving the texture and stability of soap.

Chemical name: Octadecanoic acid

Molecular formula: $C_{18}H_{36}O_2$

Fig. 9: Stearic Acid.

Castor Oil (Ricinus Communis)

Castor oil (Ricinus Communis) is a vegetable oil obtained from the seeds of the Castor bean plant. It is rich in ricinoleic acid, which gives it its emollient properties. It is Especially valued in herbal and natural cosmetic products for being plant-based, skin-friendly, And effective at dispersing pigments.

Fig. 10: Castor Oil.

Role

Acts as a moisturizer (emollient) – keeps baby skin soft and prevents dryness

Provides rich, creamy lather even in hard water

Works as a humectant – attracts moisture to the skin

Helps improve transparency and smooth texture

Sodium Hydroxide

Sodium hydroxide is a strong alkali used in the saponification process for soap preparation. It reacts with oils and fats to form soap and glycerin.

Chemical name: Sodium hydroxide

Molecular formula: NaOH

Fig. 11: Sodium Hydroxide.

Glycerine

Glycerine, also known as glycerin or glycerol, is a natural compound derived from vegetable oils and fats. Glycerine is a polyol compound with the chemical formula C3H8O3. It consists of a three-carbon chain with three hydroxyl groups (-OH) attached.

Chemical formula C3H8O3

Water

Water is used as a solvent in the soap-making process. It dissolves sodium hydroxide and facilitates the saponification reaction.

Chemical formula: H_2O

Ethanol

Ethanol is used as a solvent and helps in improving the transparency of glycerin soap base.

Chemical name: Ethyl alcohol

Molecular formula: C_2H_6O

Sucrose

Sucrose is added to enhance the transparency and improve the texture of the soap.

Chemical name: Sucrose

Molecular formula: $C_{12}H_{22}O_{11}$

Fig. 12: Sucrose.

Process

Step 1 (Soap base preparation)

Preparation of lye solution: Take distilled water in heat resistant containers. Slowly add NaOH into water Stir until fully dissolved. Allow to cool to 35 to 40°c.

Oil phase Preparation : Weight Coconut oil ,steric acid and Castor oil. Heat gently at 60-70°C until Completely melted.

Saponification : Slowly pour cooled lye solution into melted oils. Continue mixing until trace stage (thick consistency)

Heat mixture on double boiler Stir continuously Mixture becomes gel like & semi-transparent complete saponification (no oil separation).

Add glycerine & mix. Add dissolved sugar solution Slowly add ethanol Continue gentle heating until soap becomes clear

Remove from heat Pour into small silicone mould Spray alcohal to remove bubbles. Allow to set for 12-24 hours.

Step 2 (Melt and Pour Method)

1. Melt the Soap Base: Cut the soap base into small pieces. Heat it in a double boiler or microwave until it melts. Stir it.

2. Add Scents and Herbs: Take the melted soap off the heat. Add essential oils and herb (Calendula oil, Neem oil, lavender oil, Aloevera gel, vit e.). Mix well.

3. Pour into Moulds: Pour the liquid soap into molds. Tap the molds gently to remove air bubbles.

4. Let It Cool: Leave the soap to cool and harden for a few hours. Once it is solid, take it out of the moulds.[3,13]

Formula

For soap base:

Sr. No	Ingredients	F1	F2	F3	F4	F5	Role
1.	Coconut oil	16 ml	16 ml	16.3ml	16.3ml	15ml	Cleansing, good lather
2.	Stearic acid	12 g	7.5 g	7.5 g	7.5g	8g	Hardness, structure
3.	Castor oil	4.1ml	5.2ml	5.2ml	5.5ml	5ml	Creamy foam mildness
4.	NaOH	4 g	3.5 g	3.5 g	3.5 g	3.5g	Saponification
5.	Glycerin	5.9ml	5 ml	5.9ml	6ml	6ml	Transparency, humectant
6.	Sugar	0.5 g	0.5g	0.5g	0.5g	0.2g	Transparency enhancer
7.	Ethanol	5ml	6.3ml	5ml	6.3ml	6ml	Clear appearance
8.	Distilled Water	qs	qs	qs	qs	qs	-
9.	Rose oil	qs	qs	qs	qs	qs	Fragrance

For soap:

Sr. No	Ingredients	F1	F2	F3	F4	F5	Role
1.	Calendula oil	1.5ml	1 ml	1.5ml	1.5ml	1.5ml	Anti- inflammatory
2.	Neem oil	0.5ml	0.2ml	0.5ml	0.5ml	0.5ml	Anti – bacterial
3.	Lavender oil	0.1ml	0.1ml	0.1ml	0.1ml	0.1ml	Calming, fragrance
4.	Aloe Vera gel	2.5g	2.5g	2.5g	2.5g	2.5g	Moisturizing
5.	Vit. E	0.1ml	0.2ml	0.2ml	0.2ml	0.2ml	Antioxidant, protective

Physical parameter

Organoleptic Evaluation Parameters

Colour and shape: Evaluated by visual observation.

Appearance: Refers to the overall look of the soap. It should be free from cracks, rough surfaces, air bubbles, or uneven texture.

Fig. 13: Formulated Baby Soap.

Odour/Fragrance: Assessed by smelling the soap. It should possess a pleasant and characteristic herbal aroma derived from plant extracts or essential oils. No rancid or strong chemical odour should be present.

Texture/Feel: Determined by touching the soap. The soap should feel smooth and firm, neither too soft nor excessively brittle.

Consistency/Hardness: Checked by gently pressing with fingers. The soap should be firm enough to maintain its shape but not so hard that it becomes brittle.[14, 15]

Physico-Chemical Evaluation

Determination of pH

2g of prepared soap was dissolved in distilled water and stirred until completely dissolve. The pH was detected using pH meter[2]

Fig. 14: pH.

Foam Height

2g of soap was dissolved in 50ml of distilled water and shake vigorously Dissolved sample was allowed to stand for 10min the height of the foam was measured.[2]

Fig. 15: Foam Height.

Foam Retention

25ml of 1% soap solution was taken into a 100ml graduated measuring cylinder The cylinder was covered with band and shake 10 times. The volume of foam at 1min interval for 4min Was recorded.[2]

Skin Irritation

No significant skin irritation or adverse reaction were observed during patch testing on adult skin.

Fig. 16: Skin Irritation Test.

Determination of TFM [Total Fatty Matter]

In this procedure approximately 10 g of the soap sample was taken and dissolved in 150ml of water Distilled]

↓

It was dissolved by heating.

↓

Then this soap solution was treated with 20% sulphuric acid and heated till the solution get cleared

↓

Fatty acids would be observed at the surface or the film which were then solidified by the addition of 7g of Bees wax and again heated

↓

Cake formation takes place and it was remove and weighed

TFM (%) = (Weight of fatty matter / Weight of sample) × 100.[2]

Moisture content

About 10 gram of the material were heated in a hot air oven at 100 to 105 degrees Celsius for an hour.

↓

After that deducted the true weight of the tarred china dish from the total weight of the sample and dish.

↓

The weight of the material was recorded, and caleulating the percentage of the moisture content

Moisture (%) = (Loss in weight / Initial weight) × 100.[15]

Fig. 17

Fig.18

Result:

Sr. No	Parameters	F1	F2	F3	F4	F5
1.	Colour	Pale yellowish	Pale yellowish	Pale yellowish	Transparent amber	Pale yellowish
2.	Odour	Slightly Rose essence	Slightly Rose essence	Slightly Rose essence	Slightly Rose essence	Slightly Rose essence
3.	Shape	Rectangular	Rectangular	Rectangular	Rectangular	Rectangular
4.	Appearance	Good	Good	Good	Good	Good
5.	Texture	Smooth	Smooth	Smooth	Smooth	Smooth
6.	pH	7	6.9	6.8	6.2	7.3
7.	Foam Height	10cm	20cm	16cm	22cm	10cm
8.	Foam Retention	5min	4min	10min	12min	5min
9.	Skin irritation	No irritation	No irritation	No irritation	No irritation	No irritation
10.	Hardness/ Consistency	Good	Good	Good	Good	Good

RESULTS

Fig. 18

SUMMARY AND CONCLUSION

The present study successfully achieved its aim of formulating and evaluating a mild, skin-friendly syndet-based baby soap using a combination of natural oils and herbal ingredients such as calendula, neem, lavender, aloe vera, and vitamin E. The formulation process involved systematic preparation of a soap base through saponification followed by incorporation of active ingredients using the melt-and-pour method, ensuring uniformity and stability. The developed formulations (F1–F5) were evaluated through organoleptic and physicochemical parameters, where all batches showed good appearance, smooth texture, acceptable hardness, and pleasant fragrance. The pH values (6.2–7.3) were found to be suitable for baby skin, while foamability and foam retention indicated satisfactory cleansing performance. Importantly, no signs of skin irritation were observed during patch testing, confirming the safety and mildness of the formulation. Among the formulations, F4 showed comparatively better performance with a pH of 6.2, highest foam height (22 cm), and maximum foam retention time (12 min), indicating superior cleansing and lathering properties. The moisture content of the formulated syndet-based baby soap was found to be 8%, and TFM is 68.4% Overall, the results demonstrate that the formulated syndet-based baby soap effectively combines cleansing, moisturizing, and protective properties, making it suitable for delicate infant skin. The study highlights the potential application of herbal ingredients in developing safer baby care products, and future research can focus on long-term stability studies, microbial evaluation, and clinical trials to further validate its efficacy and commercial viability.

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