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LITERATURE REVIEW ON EVALUATION OF PHYSIO-CHEMICAL PROPERTIES OF COSMETIC PRODUCT

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ABSTRACT

Cosmetic products must meet specific quality standards to ensure their safety, effectiveness, and consumer satisfaction. The evaluation of physico-chemical properties plays a vital role in assessing product performance, stability, and compatibility with skin. This literature review highlights various physico-chemical parameters such as pH, viscosity, spreadability, density, foaming ability, emulsion type, and rheological behavior, which directly affect the formulation's quality and shelf life. These properties are critical in determining the product's texture, appearance, ease of application, and user experience. Standardized testing methods including viscometry, pH metry, centrifugation, stability testing, and microbial analysis are discussed in detail. The review also addresses the influence of environmental conditions and storage on product behavior. Overall, this study emphasizes the importance of thorough physico-chemical evaluation during the formulation and development phases to ensure regulatory compliance, consumer safety, and market success of cosmetic products.

KEYWORDS: Cosmetic products, physico-chemical properties, viscometry.

INTRODUCTION

Cosmetics

Fig. 1:- Cosmetic.

In 21st century, the winds of changes in the society are blowing forcefully in all parts of world for application of cosmetic. Cosmetic word is originated from Greek **word "Kosmeticos"** means adorn and preparation, which is used for this purpose, is known as cosmetic.

We can define the cosmetic as "Cosmetic are external preparation meant for to apply on external part of the body i.e., nails, skin, hair for colouring, covering, softening, cleaning, nourishing, waving, setting, mollification, preservation, removal and protection" etc.

The **"active life"** of any cosmetic preparation begins the moment it is brought in contact with the skin/hair/teeth/or nails and ends when it is removed or has evaporated. During it is active life; it has intimate reciprocal relationship, which results, cosmetic changes on the body.

In modern cosmetology, the all products of cosmetic preparations manufactured under strict quality control conditions to achieve an absence of claims on both appearance and packing. There is varieties of cosmetic preparations are used which can be classifying by various ways:[1]

Types of Cosmetics

- **Skin:** Powder, Lipstick, Rouge, Creams, Lotions and Solutions etc.
- **Hairs:** Shampoo, Conditioners, Creams, Bleach, Colouring preparation etc.
- **Nails:** Nail lacquers, Lacquers removers etc.
- **Teeth:** Eyeliner, Mascara, Eye shadow and Eyebrow pencil etc.

According to Purpose of cosmetics

- **Emollient preparation:** Cold creams, Vanishing creams, Foundation creams, and Lotion and Solutions etc.
- **Cleansing preparation:** Creams, Shampoo and Rinses etc.
- **Decorative preparations:** Lipstick, Rouges, Eyeliner, Lacquers and Dressing preparations.
- **Deodorant / Antiperspirant:** Spray, Sticks, and Mouthwashes.
- **Protective preparations:** Creams and Powders.
- **Preparation for Enjoyment:** Salts, Powders, Oils and Milks.

Cosmetic Product List

- Skin Care
  - Face
  - Body
  - Sun protection
- Hair Care
  - Cleansing
  - Conditioning
  - Styling
- Nail Care
  - Nail polish
  - Others
- Other Cosmetic Products

- ❖ Perfume
- ❖ Deodorants
- ❖ Bath product

COSMETIC PRODUCT LIST

Skin Care

- ➢ **Face Care**

Face Care refers to the routine practices and product used to maintain the health, cleanliness, and appearance of the skin on the face. It includes cleansing, moisturizing, exfoliating, and protecting the skin to prevent issues like acne, dryness, and premature aging.

Fig. 2:- Face Care.

- ➢ **Body Care**

Body Care refers to the routine practices and product used to cleanse, moisturize, protect, and maintain the health and hygiene of the skin on the body. It helps keep the skin soft, smooth and free from issues like dryness, irritation, or body odor.

Fig. 3:- Body care.

- ➢ **Sun Protection**

Sun Protection refers to the method and products used to shield the skin from the harmful effects of ultraviolet (UV) rays from the sun. It helps prevent sun burn, premature aging, and reduces the risk of skin cancer.

Fig. 4:- Sun Protection.

Hair Care

- **Cleansing**

Cleansing is the process of removing dirt, oil, sweat, makeup, and impurities from the skin to keep it clean and healthy. It is the first and essential step in any skincare routine.

Fig. 5:- Cleansing.

- **Conditioning**

Conditioning is the process of improving the texture, moisture, and manage ability of hair or skin by applying a product that nourishes and protects it. It helps restore softness, smoothness, and strength.

Fig. 6:- Conditioning.

- **Styling**

Styling is the process of arranging, shaping, or designing hair or appearance using specific products or tools to achieve a desired look. It helps enhance personal grooming and fashion.

Fig.7:- Styling.

Nail Care

- **Nail Polish**

Nail Polish is a colored cosmetic liquid applied to fingernails or toenails to decorate, protect, and enhance their appearance. It dries to form a hard, shiny coating.

Fig. 8:- Nail Polish.

Other Cosmetic Products

- **Perfume**

Perfume is a fragrant liquid made from essential oils, aroma compounds, and solvents, used to give a pleasant and lasting scent to the body or surroundings.

Fig. 9:- Perfume.

- **Deodorants**

Deodorants are personal care products applied to the body, especially underarms, to prevent or mask body odor caused by bacterial breakdown of sweat.

Fig. 10:- Deodorants.

- **Bath product**

Bath Products are personal care items used during bathing to cleanse, moisturize, and refresh the body. They help maintain hygiene and enhance the bathing experience.

Fig. 11:- Bath Product.

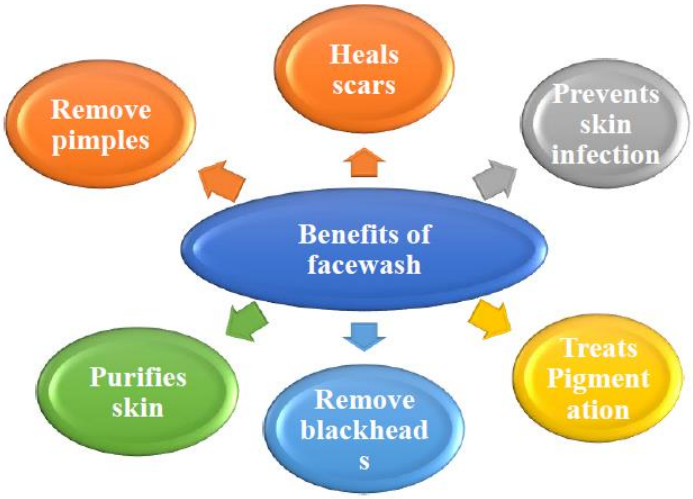
AIM

- To prepare and evaluate the physio-chemical properties of cosmetic product like face wash.

FACEWASH

Fig. 12:- Facewash.

A face wash, also known **"facial cleanser"**. A face wash is a skincare product, typically a foamy or gel-like cleanser, specifically designed to remove dirt, oil, impurities, and makeup from the face. It's a fundamental part of a skin-care routine, helping to cleanse the skin and maintain its hygiene. Face washes come in various formulations to cater to different skin types and concerns, like oily, acne-prone, or dry skin.



SPECIFIC REASON

- **Essential Skincare product**
- ✓ Facewash is a fundamental product in many skincare routines, making it a staple for many users.
- **Daily Use**
- ✓ Facewash is typically used daily, often twice a day, which can contribute to its high usage rate.
- **Basic Hygiene**
- ✓ Facewash is often seen as a basic hygiene product, similar to toothpaste or shampoo, which can contribute to its widespread use.
- **Skincare Awareness**
- ✓ The growing awareness of skincare and the importance of cleansing the face can lead to increased usage of face wash.
- **Accessibility**
- ✓ Facewash is widely available in various formats, price points, and brands, making it accessible to abroad range of consumers.

TYPES OF FACEWASH

a. Cream based facewash
b. Gel based facewash
c. Liquid based facewash
d. Face wash in powder form

A. CREAM BASED FACEWASH

Fig. 13:- Cream Based Facewash.

A cream-based facewashes as well as moisturizer your skin. A cream-based facewash is usually thick, creamy, and contains essential moisturizing elements like botanical oils. It will help you in getting rid of any dirt, sweat, makeup, or bacteria. Cream based facewashes creamy cleansers work best for dry skin. They leave the skin void of all impurities without further stripping it of essential natural oils.[2]

B. GEL BASED FACEWASH

Fig. 14:- Gel Based Face wash.

Gel facewash is a water-based facewash with a gel-like texture that are typically made from the extracts of flowers and essential oils. Gel facewash that can help balance your skin's PH. Facewash is recommended for sensitive and irritative or itchy skin type. Although many gel facewash remove extra oil, they do not bear your skin of all its oil and thus are good for dry skin as well. Gel facewash is the facewash for you are in need of deep cleansing. By unclogging your pores with a mild formula that causes little irritation to the skin, it allows for a through cleansing of your pores and removes dirt and excess oil off the surface of your skin at the same time.[3]

C. LIQUID BASED FACEWASH

Fig. 15:- Liquid Base Facewash.

Liquid based facewash have been widely used in pharmaceutics due to their high dosing flexibility, ease of swallowing, and quick onset of action. Typically, they are categorized as monophasic and biphasic formulations, where in within these two broad categories lies a wide range of dosage forms. In monophasic liquid the active pharmaceutical ingredient (API) is completely dissolved within the vehicle, while in the case of biphasic liquids, the API does not completely dissolve and instead is suspended or dispersed within the vehicle, forming two phases. Indeed, the choice of liquid dosage form is dependent upon various factors, where the type of API and the desired therapeutic effect are considered the major elements.[4]

D. FACE WASH IN POWDER FORM

Fig. 16:- Face wash in Powder Form.

Think face washes, but without the water part so you're left with just the powder. That is exactly what a cleansing powder is cleansers in the form of powders, in which you can add anything as per your discretion and skin's convenience. Powder cleanser is a dehydrated version of liquid cleanser. They pack a punch with highly potent enzymes and ingredients like rice, oats, and other minerals that are pulverized. These are DIY powders, which means you are in control of how you use it, hence you control the cleanse. You want to merely cleanse your face, use more water and less powder. You want to exfoliate, add more powder and less water; it really is in your hands.

SKIN TONES TYPES

Fig. 17:- Skin Tone Types.

NORMAL SKIN TONE

Normal skin tone refers to skin that has a balanced and even complexion, without any significant discoloration or imperfections. It's often characterized by:

- A smooth texture
- Even pigmentation
- A healthy glow
- No excessive oiliness or dryness

FACTORS

- **Melanin:** This pigment determines skin color, with higher levels resulting in darker tones.
- **Genetics:** Predisposition to certain skin tones is inherited from parents.
- **Sun Exposure:** exposure to the sun can lead to turning or darkening of the skin.

VARIATIONS

- **Fair:** Light skin color, often with a pale or pinkish hue.
- **Light:** Slightly darker than fair, with a more yellowish or brown tint.

- **Medium:** Falls between fair and dark, with a range of brown tones.
- **Dark:** Rich, deep brown or black skin color, with high levels of melanin.

Fig. 18:- Normal Skin Tone.

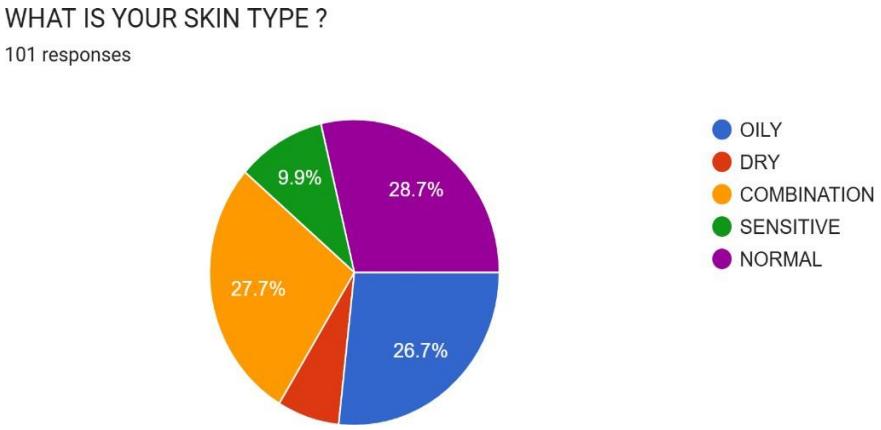


Fig. 19:- Skin Types.

GEL

A gel is a solid or semisolid system of at least two constituents, consisting of a condensed mass enclosing and interpenetrated by a liquid. The characteristic of gel and jelly is the presence of some form of cutaneous structure, which provides solid like properties. Gels and jellies are composed of small number of solids dispersed in relatively large amount of liquid, yet they possess more solid-like than liquid-like character.

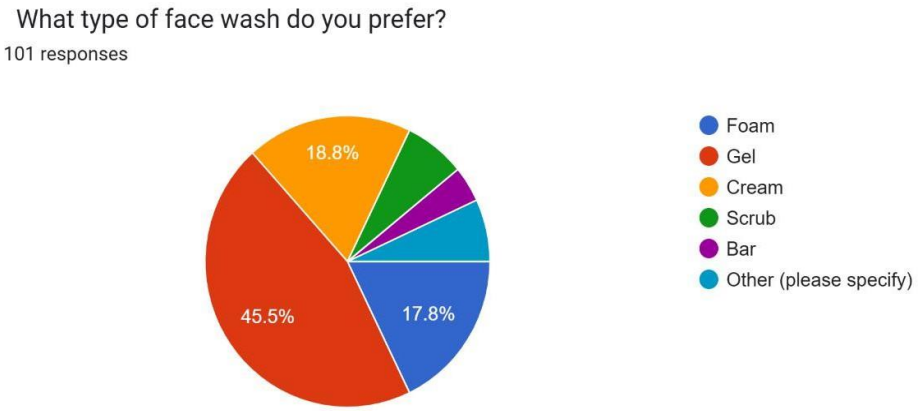


Fig. 20:- Face wash Categories.

Fig. 21:-Marketed Brands.

METHODOLOGY AND PROCEDURE

Plant Profile

- **Carica Papaya**

Carica papaya is species of fruit-bearing plants and belongs to the family knows as **"Caricaceae"**. It was first domesticated in Mesoamerica, within modern-day southern Mexico and Central America. The papaya is a small, sparsely branched tree, usually with a single stem growing from 5 to 10 m (16 to 33 ft) tall, with spirally arranged leaves confined to the top of trunk. The plant is cultivated in Sri Lanka, Tanzania, Hawaii, and Florida. Carcia papaya seeds are high in vitamin C, contain antioxidant such as phenolic compound and flavonoids. Incorporating papaya seed extract or oil into skin care formulation may help combat sign of aging and environmental damage. Papaya seed oil is rich in moisturizing fatty acid, such as oleic acid and linoleic acid, which can help hydrate and nourish the skin. It is often used in moisturizers creams and lotions to provide long-lasting hydration and improve skin texture.[5]

- Hyaluronic acid was extracted from gallus species.

Fig. 22:- Carica Papaya.

INGREDIENTS

Table 1:- Carica Papaya Face Wash Ingredients.

S. No.	Ingredients	Quantity
1	Papaya seed oil	29.5gm
2	Hyaluronic acid	0.5gm
3	Disodium lauryl sulfosuccinate	5gm
4	Cocamidopropyl betaine	1.5gm
5	Xanthan gum	0.1gm
6	Sodium cocoyl glutamate	3gm
7	Propylene glycol	1gm
8	Triethanolamine	0.05gm
9	Phenoxyethanol	0.25gm
10	Benzyl alcohol	0.25gm
11	Rose oil (drops)	Q.s
12	Distilled water	Q.s

Preparation and Extraction

Fig. 23:-Preparation.

❖ **Preparation and extraction of Carica papaya seed oil by Clevenger apparatus**

The fresh papaya seed were initially washed and then dried under shade for 5 to 10 days and then powdered. The powder sample was weighed and stored in air tight container and perform extraction using Clevenger apparatus.

- 300ml of water was added into the round bottom flask of Clevenger apparatus. 50gm of powdered papaya seed was added to the flask and fitted into the Clevenger extractor and allowed to run the apparatus for 6 hours at 40℃.
- The mixture in the set-up was heated and vapor produced was subsequently condensed by water flowing in and out of condenser. The supernatant layer formed is the papaya seed oil and the down layer is water.
- At the end of extraction, we can easily separate the oil. The process was continued until a sufficient amount of papaya seed oil was obtained.[6][7]

Fig. 24:- Extraction.

FORMULATION OF FACIAL GEL CLEANSER [FGC]

Phase A

Xanthan gum was dispersed in distilled water with continuous stirring and kept the beaker aside to swell the xanthan gum to form a gel.[8]

Phase B

To distilled water, required quantity of Phenoxyethanol and Benzyl Alcohol was dissolved by heating on water bath and then the solution was cooled. Propylene glycol, Sodium cocoyl glutamate, Disodium lauryl Sulfosuccinate and Cocamidopropyl betaine was added into it.[8]

Phase C

Further required quantities of extracts were homogenized and both mixtures were then added into xanthan gum gel base with continuous stirring. Triethanolamine was added drop wise to the formulation for the adjustment of required skin pH and to obtain the gel of required consistency.[8]

PREPARATION OF FACIAL GEL CLEANSER

In the study, six formulation were prepared. These preparations are denoted as FGC1, FGC2, FGC3, FGC4, FGC5, and FGC6.

Table 2:- Facial Gel Cleanser.

Ingredients of facial gel cleanser	FGC1 %W\W	FGC2 %W\W	FGC3 %W\W	FGC4 %W\W	FGC5 %W\W	FGC6 %W\W
Papaya seed oil	0.5	0.75	2	1	1.5	1.75
Hyaluronic acid	2	1.75	0.5	1.5	1	0.75
Disodium lauryl sulfosuccinate	2	2	2	2	2	2
Cocamidopropyl Betaine	1	1	1	1	1	1
Xanthan gum	1	1	1	1	1	1
Sodium cocoyl glutamate	2	2	2	2	2	2

Propylene glycol	2	2	2	2	2	2
Triethanolamine	2	2	2	2	2	2
Phenoxyethanol	0.5	0.5	0.5	0.5	0.5	0.5
Benzyl alcohol	0.5	0.5	0.5	0.5	0.5	0.5
Rose oil (drops)	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S
Distilled water q.s	Q.S	Q.S	Q.S	Q.S	Q.S	Q.S

EVALUATION OF FACE WASH

Physical evaluation:

The physical properties such as appearance, color and consistency were determined visually. The physical appearance of a facial gel cleanser is an important aspects of its overall quality and acceptability.

- **Colour:** The colour of the face wash formulation was checked visually.
- **Odour:** The formulation was evaluated for its odour by smelling it.
- **Consistency:** It was determined manually.[10]

Fig. 25:-Physical Evaluation.

Washability

The washability of a facial gel cleanser can be evaluated through a series of tests that assess the ability to be easily rinsed off the skin without leaving any residue. Washing can be done by rinsing the substrate with water using a massaging motion.[11][12]

Fig. 26:- Washability.

Measurement of pH

pH of the facial gel cleanser is important to evaluate as it affects the skin natural pH balance and causes irritation. Calibrate the pH meter properly with buffer solution before measuring the sample. Measure the pH by inserting the pH electrode into the gel solution and record the value. Facial gel cleanser was measured by using a calibrated pH meter at constant temperature and average pH is calculated.[11][12]

Homogeneity

The formulation is a set on a Container and homogeneity was tested by visual inspection. Visual evaluation includes Evaluation of appearance by observing the gel cleanser's color, clarity and consistency in transparent color.[13]

Spread Ability

The formulation of gel was placed over one of the slides. The other slide was placed on the top of the gel, such that the gel was sandwiched between the two slides. The spread ability is expressed in terms of time in occupied by a distance of 6 cm the slide. The weight of 100 gm was placed on the upper slide, so that the gel between the two slides was pressed evenly to a thin layer. The weight was removed and the excess of the gel adhering to the slides was scrapped off. The two slide in position were fixed to stand without slightest disturbance and in such a way that only the upper slide to slip off freely by the force of weight tied to it. The weight of 20 gm was carefully attached to the upper slide. The time taken for the upper slide to travel the distance of 6 cm and separated away from the lower slide under the influence of the weight was noted. The experiment was repeated three times on both formulated gels. Spread ability was calculated by using the following formula.[14]

Irritancy Test

Where,

$$S = M \times \frac{L}{T}$$

S- Spread ability

M- Weight on the upper slide (20 gm) L- Length of the glass (6.5 cm)

T- Time in second

The irritancy of a facial gel cleanser can be evaluated through various test these includes. Patch tests in which the gel was applied on left hand dorsal side surface of 1 sq.cm and observed in equal intervals up to 24hrs for irritancy, redness and oedema.[13]

Grittiness

The grittiness of a facial gel cleanser refers to the principle of presence of particles or grains that can cause a rough o or abrasive sensation on the skin. The test procedure includes sample preparation of a gel cleanser in sufficient amount and then visually inspect the cleanser for any visible particles then perform touch the test by applying a small amount of gel cleanser to the sensitive area of skin.[13]

Fig. 26:-Grittiness.

Viscosity

The viscosity of a facial gel cleanser is important physical property that affects its texture, spread ability. The value of viscosity is recorded in centipoise(cP) the viscosity of facial gel cleanser was determined by using digitals **Brookfield viscometer.** 50 ml of gel cleanser is taken into 100 ml of beaker and spindle 64 attached to the viscometer. Then it dipped into the beaker, adjust the speed into 100 rpm and record the viscosity reading.[13][15]

Fig. 27:- Viscosity.

Foam ability

The foam ability of facial gel cleanser is an important property that effects its cleaning efficacy. Small amount of gel has been taken and suitable foam generation method is selected. Sample is added into a measuring cylinder containing water. Initial volume was noted, cylinder was shaken for ten times and the final volume was noted. Observe and record the foam stability over a specified time period.[11]

FTIR (Fourier transform infrared) spectroscopy

When infrared radiation passes through a sample, some of the radiation is absorbed and radiation that passes through the sample is recorded. FTIR is the preferred method of infrared spectroscopy for several reasons:

- ✓ Is does not destroy the sample.
- ✓ It is faster than older techniques.
- ✓ It is significantly sensitive and precise.

Based on the FTIR spectrum, identify the presence of key ingredient such as surfactants, moisturizers and preservatives. It determines the level of purity or contamination in the sample. It compares the spectrum to that of a standard or reference material to evaluate the products authenticity or consistency. Some common functional groups and their corresponding FTIR spectral regions are:

- ✓ Hydroxyl group(-OH):3500-3200 cm??
- ✓ Carboxyl group(-COOH):1700-1500 cm??
- ✓ Carbonyl group(-C=O):1800-1600 cm??[16]

CONCLUSION

By this project we conclude about the physio-chemical properties of cosmetic product is a crucial aspect of ensuring their safety, efficacy, and quality. This project has highlighted the importance of rigorous testing and evaluation of cosmetic products to determine their physical and chemical properties.

By conducting through physio-chemical properties, manufactures can ensure that their cosmetic products meet the highest standards of quality, safety, and efficacy, ultimately benefiting consumers and the industry as a whole.

By evaluating key parameters such as pH, viscosity, spread ability, rheology, and particle size, manufacturers can maintain consistent product standards and meet regulatory requirements. These analyses help in detecting formulation issues, optimizing product performance, and extending shelf life. Overall, systematic physicochemical testing is essential for the successful development and commercialization of safe, high-quality cosmetic formulations.

In our major project we will prepare a gel formulation and we will do the evaluation tests for respective preparation.

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