



IJPPR

INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals

ISSN 2349-7203



Human Journals

Research Article

July 2024 Vol.:30, Issue:7

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Formulation and Evaluation of Antiacne and Skin Whitening Polyherbal Facewash



IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals



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Submitted: 20 June 2024
Accepted: 27 June 2024
Published: 30 July 2024

Keywords: Facewash, Herbal formulations, Anti-acne, Anti-inflammatory, Anti-microbial

ABSTRACT

The demand for herbal formulations is quite significant worldwide. The human skin is the organ most susceptible to illness-causing microorganisms and diseases. It requires a lot of attention and defence as a result. Hormone imbalances during puberty can cause a variety of skin problems. Acne is the most common type of skin disease. Face and neck are most typically affected regions. Eliminating oil from the face serves as a preventive step. This has to be washed and cleaned properly. There are now antibiotic gels, anti-acne washes, and masks on the market that include artificial medications. Regretfully, some medications may have negative side effects in addition to curing diseases and eliminating infections. This requirement led us to develop the idea of employing herbs and other plant-derived components, which are very helpful in treating a variety of skin-related problems. This study set out to create and assess a herbal face wash gel including extracts of liquorice, green tea, orange peel, and beetroot, as well as other ingredients such gelling agent, preservative, humectants, carrier, and scent. A number of characteristics, such as colour, appearance, consistency, pH, viscosity, etc., were assessed for the prepared formulation. Key phrases: cleansing face, formulas made using herbs, preventative against acne antioxidant and antimicrobial.



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1. INTRODUCTION

The skin makes up almost 15% of an adult's total body weight, making it the biggest organ in the body. The skin makes up almost 15% of an adult's total body weight, making it the biggest organ in the body. Among its many essential duties are defence against physical, chemical, and biological threats; it also keeps the body from losing too much water; and it plays a part in thermoregulation (Kanitakis J., 2002). To keep skin healthy, clear and glossy, a balanced nutrition is required. Apart from the balanced nutrition, hormonal changes especially during the puberty in both sexes cause many changes in the body (Brown S Ketal., 1998). Among various changes, Acne vulgaris is the most common.

Acne vulgaris is a very common skin condition that almost everyone experiences at least once in their life. It usually shows up during the teenage years but can also affect many adults between 20 and 30 years old. It's basically when your skin gets pimples and blackheads (Sowmya K. Vetal., 2015). Acne can exert profound implications on both mental and physical well-being, often correlating with heightened levels of depression and anxiety irrespective of its severity. However, these psychological effects tend to improve with proper treatment. Additionally, acne can lead to permanent scarring that is challenging to treat. Ordinary soaps cause the delicate facial skin to become dry and lose its suppleness. The idea is to create a herbal face wash to address the issues caused by synthetic ones. Herbal face wash aims to offer gentle cleansing without drying the skin, while also providing benefits like anti-wrinkle, anti-acne, moisturizing, and enhancing fairness. Additionally, they don't require harsh preservatives to maintain stability (Sehgal A etal., 2023) ,(Yadav N etal., 2021). Gels are materials that resemble solid jelly and can be soft and weak or firm and durable. They consist mostly of a liquid material kept together by a three-dimensional web of interconnecting connections. This network structure is what gives gels their solidity and allows them to behave like solids even though they are mostly liquid. Moreover, this cross-linkage confers adhesive properties, facilitating adherence to surfaces (Yadav S etal 2019).

FACEWASH

A facial cleanser, commonly referred to as a skin wash, is a cleansing agent specifically formulated to cleanse the face without causing excessive dryness. It is recognized as a suitable option for all skin types (Agarwal N etal., 2023). Face washes effectively remove dirt and oil while providing moisture to dry skin. Both face washes and cleansers are utilized to eliminate impurities, excess oil, and toxins from the facial skin (Solanki D et al, 2020).

Properties of ideal face wash

1. The exfoliation accelerates the blood circulation and promotes skin regeneration and rejuvenation.
2. Facial pores and Oily skin are caused by over secretion of sebum by sebaceous glands which clogs the makes the skin oilier.
3. Herbs and botanicals in cleansers are necessary to unclog pores and lessen oil accumulation on oily skin. Anti-inflammatory and antioxidant-rich ingredients in these exfoliating cleansers help to repair and nourish damaged skin.
4. It must be both aesthetically pleasing and sturdy.
5. It ought to spread without dragging at all.
6. It shouldn't feel oily or greasy while applying.
7. The residue of the cream shouldn't get thick when the water evaporates.
8. Rather of being absorbed, it should physically flush the skin and open the pores.
9. After usage, the skin should still have a thin layer of emollient film on it (P.P Sharma), (Yadav N et al., 2021).

2. HERBS USED IN FORMULATION OF FACE WASH

2.1 Green tea


Green tea is widely consumed as a dietary supplement. In China, green tea is used for medicinal purposes in the past 4000 years (Gupta et al., 2014). It can be divided into three categories which are depending on its oxidation process. Non oxidative form is called green tea, partially oxidized form is oolong tea and completely oxidized form is black tea. There is another form of tea which is called white tea (Sinija et al., 2008). Green tea has polyphenolic compound which is called Epigallocatechin-3-gallate (EGCG). Green tea is less processed or non-oxidative form so it has maximum antioxidant property than other forms of tea. Besides polyphenolic content, green tea contains flavonoids and glycosides (Khurshid et al., 2016), (Singhal A et al., 2013). It has many health promoting effects like anti-carcinogenic, anti-inflammatory and antibacterial effects. Now days, it is widely used to reduce weight as dietary supplements. Green tea contains caffeine which shows many side effects if takes in excess. It can stimulate central nervous system which leads to Insomnia, restlessness and

tremors. Green tea also affects liver and interferes with the metabolism of drugs like MAO inhibitors (Nawab et al., 2015).

2.1.1. Taxonomical classification of *Camellia sinensis* (Green tea)

- Kingdom- Plantae
- Phylum- Tracheophyta
- Class- Magnoliopsida
- Order- Ericales
- Family- Theaceae
- Genus- Camellia
- Species- *Camellia sinensis* (Kokate CK et al.,2005)

Table no 1: Drug profile: *Camellia sinensis*

<i>Camellia sinensis</i>		
<p>Synonym: Green tea</p> <p>Biological Source: It is obtained from evergreen shrub or small tree leaves and leaf buds of plant known as <i>Camellia sinensis</i>.</p> <p>Family: Theaceae</p>	<p>Uses:</p> <p>Anti-inflammatory, Antimicrobial, Astringent property, Skin care, UV protection, etc (Yapar E A et al., 2013).</p>	

2.1.2 Active constituents of *Camellia sinensis*

Camellia sinensis contains various active constituents which includes catechins which are potent antioxidant such as epigallocatechin gallate (EGCG), epicatechin gallate (ECG), epigallocatechin (EGC), and epicatechin (EC) (Yang C.S., et.al., 2011). It also contains caffeine, theanine, polyphenols such as flavonoids and phenolic acids; Vitamins such as vitamin C, vitamin B2 (riboflavin), vitamin B3 (niacin), and vitamin E in smaller amounts; Minerals such as potassium, calcium, manganese, magnesium, and fluoride. Volatile

compounds that contribute to its aroma and flavour, includes terpenes, aldehydes, and alcohols (S. Hsu, 2004).

2.2 Beet root

Beet root powder is the natural colouring material which gives natural glow to the skin. Beetroot gives nourishment to the skin. Beta cyanine, the pigment that gives beet root its colour, is antioxidant (Ogbonna GC et al., 2021). Beet root also have the healing power. Juice from beetroot is commonly produced and contains a variety of useful chemicals, including vitamin C, vitamin B9, carotenoids, saponins, flavonoids, polyphenols, anthocyanins, and β -cyanins and β -xanthan's. It helps in the prevention of skin issues such acne, wrinkles, patches, spots, tanning, and dryness. Furthermore, it can be used as an anti-aging or wrinkle therapy, keeps your skin hydrated, and promotes the growth of healthy skin cells (Bhattacharya S et al., 2022).

Garden beet, or beetroot, is an annual crop, meaning that it develops to maturity and completes its life cycle in a single year. This plant is primarily grown for its tasty roots and leaves, but it also has soft, green leaves that you may eat. Depending on the kind of beet are cultivating, beetroot can range in color from yellow to red. Because of their bright colour, they are used to colour food and even cosmetics. They are also utilized in medications due to their potential health benefits. Thus, in addition to being delicious, those red beets are also rather useful for other purposes (EI-Beltagi HS et al., 2018).

2.2.1 Taxonomical classification of *Beta vulgaris* (Beetroot):

- Kingdom- Plantae
- Phylum- Angiosperms
- Class- Eudicots
- Order- Caryophyllales
- Family- Amaranthaceae
- Genus- Beta
- Species- *Beta vulgaris* (Kokate CK et al.,2005)

2.2.2 Active constituents of *Beta vulgaris*

Beetroot contains various chemical constituents, including betalains which are water-soluble pigments responsible for the characteristic red color of beetroot. They include betacyanins, which are red-violet pigments, and betaxanthins, which are yellow-orange pigments (El-Beltagi HS, 2018),(Ogbonna Gc et al.,2021), Betaine responsible for antioxidant activity, nitrates, vitamins and minerals including vitamin C, folate (vitamin B9), potassium, manganese, and iron. Phytonutrients such as flavonoids and carotenoids, which have antioxidant and anti-inflammatory properties (Bhattacharya S et al., 2022).


2.3. Liquorice

Liquorice, also known as yasti nad Mulethi, is derived from the root and stolon of the *Glycyrrhiza glabra* plant, belonging to the Leguminosae family and Glycyrrhiza genus. It is found in regions including India, China, Japan, and Europe. Its key chemical components include glycyrrhithic acid, glycyrrhizin, and various other compounds. Liquorice is available in gel, powder, and oil formulations, and it possesses anti-inflammatory and antioxidant properties. Additionally, it can help reduce pigmentation and skin spots (Singhal A et al., 2023), (Vaja PN et al.,2023).

2.3.1 Taxonomical classification of *Glycyrrhiza glabra* (Liquorice)

- Kingdom- Plantae
- Phylum- Angiosperms
- Class- Eudicots
- Order- Fabales
- Family- Fabaceae (Leguminosae)
- Genus- Glycyrrhiza
- Species- *Glycyrrhiza glabra* (Kokate CK et al., 2005).

Table no 2: Drug profile: Glycyrrhiza glabra

<i>Glycyrrhiza glabra</i>		
Synonym: Liquorice, Mulethi	Uses: Anti -oxidant; Anti-microbial, anti – inflammatory properties, helps to brighten and soothe itchy and irritated skin treat acne. Glabridin, a compound in liquorice, is known for its ability to inhibit melanin production, thus helping to lighten skin tone (Chavan Ankita N et al., 2022).	
Biological Source: Liquorice is obtained from the roots of the <i>Glycyrrhiza glabra</i> plant. Specifically, underground rhizomes and roots of the liquorice plant.		
Family: Fabaceae		

2.3.2 Active constituents of *Glycyrrhiza glabra*


The chief constituents of liquorice are a triterpenoid saponin also known as Glycyrrhizin (Glycyrrhizic acid) responsible for its characteristic sweet taste (Chavan Ankita N et al.,2022), other includes glabridin which helps in reducing the appearance of dark spots and pigmentation by inhibiting the enzyme tyrosinase, which is involved in melanin production, polysaccharides with moisturizing and hydrating properties, flavonoids (liquiritin and isoliquiritin) which have anti-inflammatory effects, which can help alleviate redness, irritation, and inflammation. It also contains coumarins including glycyrol and umbelliferone exhibit antimicrobial activity, used in treating acne and other skin infections (Cerulli A., et.al., 2022).

2.4 Orange peel:

Orange peel is packed with various beneficial compounds such as carotenoids, flavonoids, vitamins, minerals, polyphenols, and omegas. These compounds offer a wide range of health benefits, including support for diabetes management, cancer prevention, allergy prevention, and antimicrobial effects. When it comes to skincare, orange peel can improve skin tone, strengthen nails, enhance hair health, and prevent dry skin conditions like xerosis (Varmie EB et al., 2021), (Vaja PN et al.,2023).

Compounds such as catechol, dimethoxy phenol, cyclohexane, coumarin, acetic acid, stigmasterol, sitosterol, and vitamin E are responsible for the antioxidant qualities of orange peel. These antioxidants aid in the fight against oxidative stress and shield the skin from harm from free radicals. Orange peel is particularly rich in flavonoids and vitamin C, with levels ranging from 110.4 to 127.70 mg per 100 g of dried orange peel. Flavonoids like naringin and hesperidin, which are abundant in citrus peel, offer antioxidant, anti-inflammatory, and anti-carcinogenic effects, making them valuable for skincare products (Sir Elkhatim KA, et al., 2018).

Table no 3: Drug profile: *Citrus sinensis*

<i>Citrus sinensis</i>		
<p>Synonym: Sweet orange Biological Source: The biological source of sweet orange (<i>Citrus sinensis</i>) is the fruit-bearing tree of the same name. Family: Rutaceae</p>	<p>Uses: Skin brightening, Exfoliation, Antioxidant protection, Oil control, Soothing and calming, etc.</p>	

2.4.1 Taxonomical classification of *Citrus sinensis*

- Kingdom: Plantae
- Phylum: Angiosperms
- Class: Eudicots
- Order: Sapindales
- Family: Rutaceae
- Genus: Citrus
- Species: *Citrus sinensis* (Kokate CK et al.,2005)

2.4.2 Active constituents of *Citrus sinensis*

Orange peel contains several chemical constituents that are useful in cosmetic science for skincare formulations. Some of these constituents include Vitamin C (ascorbic acid), which is a potent antioxidant helps protect the skin from oxidative stress caused by free radicals,

promotes collagen synthesis, and brightens the complexion (Wagh V et al., 2015), Hesperidin and naringin are two examples of flavonoids with antioxidant and anti-inflammatory qualities that help shield the skin from the elements and relieve inflammation. Essential oils rich in limonene, linalool, and other volatile compounds have antibacterial, antifungal, and astringent properties, making them beneficial for acne-prone or oily skin types, Alpha hydroxy acids (AHAs) such as citric acid, which help exfoliate the skin by loosening dead skin cells and promoting cell turnover. AHAs can lessen hyper pigmentation, enhance the texture of the skin, and enhance overall skin radiance, Pectin a type of soluble fiber that helps hydrate and moisturize the skin. Pectin forms a film on the skin's surface, preventing moisture loss and promoting a smoother complexion, Polyphenolic compounds such as flavonoids and phenolic acids, which have antioxidant and anti-inflammatory properties. Polyphenols help shield the skin from UV damage, reduce inflammation, and promote skin healing, citrus bioflavonoids such as quercetin and hesperidin, which have antioxidant and anti-aging properties. Bioflavonoids can help reduce the appearance of fine lines and wrinkles, improve skin elasticity, and promote a more youthful complexion (Anilkumar V et al., 2020).

3. MATERIALS AND METHOD

3.1 Method of Preparation:

Firstly, all the crude drug material was collected including green tea leaves, orange peel, liquorice root and beetroot. Then all the ingredients were washed properly and pat dried (Singh H.P, 2015).



Fig 1: Green tea, orange peel, beetroot and liquorice powder

3.2 Preparation of herbal extracts:

Leaves of green tea, roots of liquorice, orange peel and beetroot slices were kept in hot air oven for drying below 45°C and grinded into fine powder by using the grinder (Wagh V et al., 2015). Required quantity of all the drugs were kept for maceration with rose water, shaken frequently and allowed to stand for 5 consecutive days. Followed by filtration and concentration to attain desired consistency by using rotary evaporator (S. Abdullahetal., 2013) (Mendhekar S.Y et al., 2017).

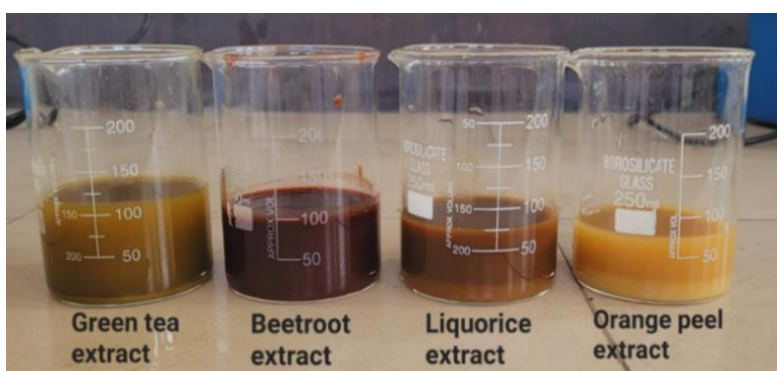


Fig 2: Extracts of different herbs

3.3 Preparation of Xanthan Gum Solution:

Xanthan gum was dissolved in a small quantity of water to generate a viscous paste.

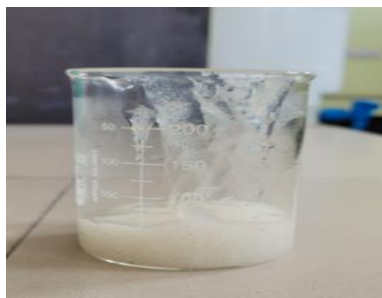


Fig 3: Xanthan gum

3.4 Formulation of herbal gel face wash:

In a clean container, equal parts of the three herbal extracts were combined. These extracts were obtained through maceration (green tea, orange peel, and liquorice). The freshly extracted beetroot juice was added to the herbal extract mixture, and it was mixed well, glycerine was added to the herbal extract mixture, and it was stirred until well combined. Xanthan gum solution was gradually added to the mixture while stirring continuously to achieve a uniform gel- like consistency. Sodium lauryl sulfate was added to the mixture as a foaming agent, and was stirred well to incorporate (Duhan P et al., 2023):.



Fig 4: Formulation F1, F2

3.5 Preservation:

Methyl paraben and propyl paraben were added to the mixture as preservatives. It was stirred well to ensure even distribution (Duhan P et al., 2023).

3.6 pH adjustment:

pH of the gel face wash was adjusted using NaOH to achieve a pH suitable for the skin (Duhan P et al., 2023):.

3.7 Mixing:

All the ingredients were gently mix until the gel was uniform in texture and color (Duhan P et al., 2023).

3.8 Storage:

Prepared herbal gel face wash was filled in a clean container, labelled accordingly and stored in a cool, dry place away from direct sunlight (Duhan P et al.,2023).

3.9 Marketed formulation

Khadi natural sandalwood & honey facewash was purchased from the local market (Duhan P et al., 2023).



Fig 5: Marketing Formulation khadi natural sandalwood& honey

4. PRELIMINARY SCREENING FOR PHYTOCHEMICALS (Kamble M.et al., 2019)

By using these assays, different organic functional groups that indicate the kind of phytochemicals present in a plant has may be found. These tests show that the extract has a variety of component classes. The experiments listed below have been performed on aqueous and alcohol extracts.

Tests for alkaloids

Dragendorff's test: To a few mg of sample extract dissolved in alcohol, 3 drops of acetic acid and Dragendorff's reagent were added and shaken well. An orange-red precipitate formed indicates the presence of alkaloids.

Tests for the presence of carbohydrates

Molisch's test: Two drops each of a-naphthol solution and concentrated sulfuric acid were applied to the extract along the test tube's sidewalls. Carbohydrates are present because of the violet tint that generated at the interface of the two liquids.

Test for saponins

Foam test: Distilled water was added to 10 mg of extract, and the mixture was agitated. The presence of saponins is shown by stable foam formation.

Test for the presence of steroids

Libermann-Burchard test: 1 ml each of acetic acid and acetic anhydride were added to the extract that had been dissolved in chloroform. The mixture was then heated on a water bath and allowed to cool. Around the edges of the test tube, one or two drops of concentrated sulphuric acid were added. The presence of steroids is indicated by the emergence of blue green hue.

Test for the presence of tannins

Ferric chloride test: Two drops of a diluted ferric chloride solution were added to the extract; the creation of a dark blue hue indicates the presence of tannins.

Test for triterpenoids

Two drops of thionyl chloride and small pieces were added to the heated extract. Triterpenoids are indicated by the production of a pink hue.

4. COMPOSITION OF DEVELOPED FORMULATION

Table no 4: Formula for Herbal gel face wash (For 50 ml face wash)

S. No.	INGREDIENTS	PARTS USED	PROPERTY	(F1)	(F2)
1.	Green tea	Leaves	Antioxidant, Anti-inflammatory, Anti-ageing, etc	10ml	12ml
2.	Orange peel	Fruit	De-tanning	5ml	6ml
3.	Beetroot	Fruit	Rejuvenating	5ml	6ml
4.	Liquorice	Roots	Anti-inflammatory and skin-lightening properties	5ml	6ml
5.	Xanthum Gum	-	Gelling agent	0.5gm	1gm
6.	Methyl paraben	-	Preservative	0.05mg	0.05mg
7.	Propyl paraben	-	Preservative	0.03mg	0.05mg
8.	Glycerine	-	Humectant	3ml	4ml
9.	Sodium lauryl sulfate (SLS)	-	Foaming agent (surfactant)	2gm	3gm
10.	Rose water	-	Flavouring agent, Emollient, cooling agent (used as vehicle)	q.s (approximately 19.42ml)	Few drops q.s (approximately 11.9ml)

5. EVALUATION PARAMETERS FOR PREPARED HERBAL GEL FACE WASH

(Vogel H.G., 2002):

5.1 Organoleptic evaluation:

The formulation was visually checked for its colour against a white background, odour of facewash was checked manually.



Fig 6: Colour of formulation F1 and F2

5.2 Consistency

The consistency of facewash was evaluated by applied on the skin.

5.3 Test for skin irritation:

Test for skin irritation was carried out by applying herbal gel face wash on hand after washing observe any itching, rashes or redness on hand by visual surveillance.

5.4 pH test:

pH of 1% aqueous solution of the formulation was measured by using a calibrated digital PH meter at constant temperature.



Fig 7: pH meter testing

5.5 Washability:

Effectively the product can be rinsed off the skin, leaving no residue or film behind. Formulation was applied on the skin and then eases and extent of washing with water was checked manually.



Fig 8: Washability test of prepared herbal face wash

5.6 Viscosity measurement:

Viscosity was evaluated using Brookfield viscometer.



Fig 9: Viscosity determination by the Brookfield viscometer

5.7 Grittiness:

The grittiness test checks if there are any rough bits in the formula. Face wash was applied and rubbed gently and observed for any granules is present. The grittiness test showed that there were no gritty particles in the herbal face wash when applied to the skin.



Fig 10: Grittiness test



Fig 11: Foamability test of prepared herbal face wash

5.8 Foamability:

Small amount of gel was taken in a petridish containing water to perform foamability test.

6. RESULT AND DISCUSSION

Two different formulations were prepared using different formulas (slight concentration changes from one another) and they were compared with standard (Marketed herbal gel face wash preparation). The prepared formulations underwent satisfactory results test for colour, smell, consistency, pH, foamability, washability, and grittiness. Comparison is given below:

Table no 5: Comparison of physical parameters of our formulations and marketed formulation

S. No.	Parameters	Observation	
		Formulation F1	Formulation F2
1.	Colour	Reddish pink	Reddish brown
2.	Odour	Characteristic	Characteristic
3.	Nature	Semisolid (Gel-like)	Semisolid (Gel-like)
4.	Consistency	Smooth and slipper	Smooth and slipper
5.	Washability	Rinse off easily	Rinse off easily
6.	Foamability	Foam appears	Foam appears
7.	pH	5.89	5.73
8.	Viscosity	460 Pa.s	480 Pa.s
9.	Grittiness	No gritty particles	No gritty particles
10.	Irritancy test	Non-irritant	Non-irritant

This study revealed that the developed herbal formulation of batch F2 was comparatively better than F1. Batch F2 was found optimum for all the parameters. So, we take batch F2 and compare it with a marketed product.

Comparative study of Formulations F1 and F2 with marketed formulation

1. Physical appearance

Formulation/ batch code	Colour	Odour	Nature	Consistency
Marketed	Reddish brown	Characteristic	Semisolid (Gel-like)	Smooth and slipper
F1	Reddish Pink	Characteristic	Semisolid (Gel-like)	Smooth and slipper
F2	Reddish brown	Characteristic	Semisolid (Gel-like)	Slightly viscous

2. pH

Formulation/ batch code	pH
Marketed	5.82
F1	5.89
F2	5.73

3. Grittiness

Formulation/ batch code	Grittiness
Marketed	No gritty particles
F1	No gritty particles
F2	No gritty particles

4. Washability/Foamability

Formulation/ batch code	Washability	Foamability
Marketed	Rinse off easily	Foam appears
F1	Rinse off easily	Foam appears
F2	Rinse off easily	Foam appears

5. Viscosity

Formulation/ batch code	Viscosity (Pa.s)
Marketed	510
F1	460
F2	480

CONCLUSION

Due to customer demand for goods that satisfy their inclination for natural and organic choices, herbal cosmetics—which employ natural ingredients—are growing in popularity in the beauty sector. There is a growing recognition of the possible advantages of incorporating natural components into personal care regimens, as seen by the increasing needs for these products. Utilising a combination of advantageous elements including orange peel, xanthan gum, liquorice, beetroot, green tea, and rose water, prepared herbal face wash has been made. The herbal face wash outperformed commercially available alternatives in terms of colour, odour, pH, consistency, washability, grittiness, and viscosity after extensive testing and review. Crucially, the formulation's whole component list is herbal, guaranteeing skin care products' dependability and safety. Two distinct formulations with slightly varying concentrations were made using two separate recipes, and the results were compared to the industry standard (marketed herbal gel face wash preparation). The created formulations were tested for colour, consistency, pH, washability, grittiness, smell, and colour, and the findings were good. In terms of evaluation criteria, the F2 formulation batch was more similar to the standard formulation. According to the study, the herbal face wash performed better than the one that is presently available in the market in a number of ways. Because it is composed entirely of natural substances, it is said to be trustworthy and safe for our skin. This implies that there is no need to be concerned about any harsh chemicals and that it will be successful.

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