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FORMULATION AND EVALUATION OF PREBIOTIC BIOGEL FROM *GARCINIA INDICA*(RIND) FOR SKIN HEALTH

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ABSTRACT

The present study focused on the formulation and evaluation of a prebiotic biogel containing *Garcinia indica* (kokum) rind extract for potential skin-care applications. Kokum rind was shade-dried, powdered, and extracted using 70% ethanol by maceration. The obtained extract was subjected to preliminary phytochemical screening, which confirmed the presence of tannins, flavonoids, carbohydrates, anthocyanins, and hydroxycitric acid. A prebiotic biogel was formulated using kokum extract along with inulin, aloe vera gel, niacinamide, glycerin, vitamin E, Carbopol 940, and other suitable excipients. The formulation was evaluated for physical appearance, homogeneity, pH, viscosity, spreadability, extrudability, prebiotic characteristics, irritancy, and stability. The formulated biogel exhibited satisfactory physical characteristics and stability, while the irritancy evaluation showed absence of redness, itching, and irritation. The combination of kokum rind extract and inulin may provide anti hyaluronidase, moisturizing, skin-conditioning, and prebiotic benefits, supporting skin hydration and skin microbiome balance. Overall, the developed *Garcinia indica*-based prebiotic biogel demonstrates promising potential as a natural topical formulation for skin health. Further studies may be required to establish its biological efficacy and long-term safety.

KEYWORDS: *Garcinia indica*, kokum, prebiotic biogel, inulin, niacinamide.

1. INTRODUCTION

Garcinia indica (Family: Guttiferae/Clusiaceae) is native to the western ghats of India. Its round or globose fruits are about 4 cm in diameter, have a fleshy skin that encloses 2–8 large pulpy seeds, and are frequently purple when ripe. Due to its fruit's exceptional vitamin C content and antioxidants including polyphenols and flavonoids, it has use in nutritious foods, skincare, and nutraceuticals. Kokum fruit rind exhibits anti-hyaluronidase, anti-elastase, antioxidant, anti-inflammatory, antiglycation, antimicrobial, and moisturizing/emollient activities, supporting its potential use in anti-ageing and skin-care formulations.

Bio-gels are polymeric materials with three-dimensional network topologies that are becoming more and more popular in environmental applications. Bio-gels, which are commonly made from natural polymers like proteins and polysaccharides, are widely accessible, highly biocompatible, and biodegradable.

The human body's second-largest microbial population after the stomach, the skin microbiota, is vital to both skin health and illness. Prebiotics are substances that are selectively utilized by beneficial microorganisms to support the health of the host, and their concept has expanded to include compounds that influence microbial populations in different environments, including the skin microbiome. Although dietary fibers such as fructans, carrageenan, and fucoidans have been widely investigated for their beneficial effects on skin health, prebiotic oligosaccharides, typically composed of 2–20 monosaccharide units, are emerging as promising agents for skin-care applications.

PREBIOTIC BIOGEL

In recent years, prebiotics have attracted growing interest in dermatology and skin care because of their potential to influence and support the skin's microbial community, extending their benefits beyond the digestive system. In this study, a Prebiotic Biogel was formulated using a combination of natural and functional ingredients, including kokum extract, inulin, aloe vera gel, glycerin, propylene glycol, vitamin E, niacinamide, and Carbopol 940. The formulation was developed to utilize the synergistic effects of prebiotic and botanical constituents in promoting skin health. Inulin acts as a prebiotic ingredient that supports the growth of beneficial skin microbiota, while kokum extract contributes moisturizing, skin-conditioning, and anti-hyaluronidase properties that may help preserve skin hydration and elasticity. Aloe vera gel provides soothing and hydrating effects, enhancing the overall

performance of the formulation. The biogel system serves as an effective carrier for the uniform distribution of active ingredients, ensuring ease of application and improved skin compatibility. The developed formulation aims to maintain skin moisture, support microbial balance, and promote a healthy, radiant complexion, making it a promising approach for topical skincare applications.

HISTORY

The development of biogel technology began in the late nineteenth and early twentieth centuries with the exploration of natural gel-forming materials such as gelatin, agar, alginate, and collagen. Throughout the mid-twentieth century, advances in biomaterials and polymer science contributed to a deeper understanding of gel structures and their biological applications. During the 1970s and 1980s, research focused on the use of biogels in wound care, tissue repair, and controlled drug delivery systems. By the 1990s and 2000s, new fabrication techniques enabled the development of biogels with improved stability, mechanical strength, and release characteristics. In the 2000s–2010s, biogels gained significant attention in regenerative medicine, cosmetic formulations, and probiotic delivery due to their biocompatibility and biodegradability. From the 2010s–2020s, academic studies investigated biogel composition, physicochemical properties, bioactive incorporation, and therapeutic performance, expanding their applications in healthcare and dermatology. Between 2020 and 2025, research increasingly emphasized natural and sustainable biogels, including prebiotic and plant-based formulations, highlighting their potential for topical delivery, wound healing, skin regeneration, and advanced biomedical applications.

IDEAL PROPERTIES

Skin type: Suitable for dry, normal, sensitive, and oily skin; lightweight and lamellar.

Usage: Apply twice daily after cleansing; use sunscreen in the morning.

Amount: Pea-sized quantity; spreads easily and absorbs quickly.

Odour: Pleasant and free from rancid smell.

Appearance: Attractive colour, preferably matching the plant extract.

Benefits: Hydrates, softens, protects, soothes, supports the skin microbiome, and helps reduce signs of ageing.

Precaution: For external use only; avoid contact with eyes and discontinue use if irritation occurs.

2. DRUG PROFILE

Fig.1 *Garcinia indica.*

Biological source: It is obtained from the dried fruit rind of *Garcinia indica* Choisy.

Family: Clusiaceae (Guttiferae).

Plant description: It is an evergreen tree growing up to about 10–15 m. The leaves are simple, opposite, glossy and leathery. Flowers are small and reddish-pink. The fruit is a globose berry, turning dark purple when mature, with several seeds. The dried fruit rind is widely used and contains phytoconstituents such as hydroxycitric acid, garcinol, anthocyanins and phenolic compounds.

3. MATERIALS AND METHODS

MATERIALS

- Garcinia indica (kokum) extract
- Gelling agent (e.g., Carbopol 940, HPMC, sodium alginate, or chitosan)
- Preservatives (e.g., methyl paraben, propyl paraben)
- Humectant (e.g., glycerol or propylene glycol)
- pH-adjusting agent (e.g., triethanolamine or sodium hydroxide)
- Distilled water
- Chemicals and reagents of analytical grade.

Fig.2 kokum powder.

COLLECTION

The fresh fruits of *Garcinia indica* (kokum) were collected from Kerala during the fruiting season. The fruit rinds were manually separated from the seeds, washed thoroughly to remove adhering impurities, and foreign materials. The processed kokum rinds were

subsequently evaluated for quality to ensure their suitability before being used for extraction and formulation studies.

DRYING

After washing, the kokum rind was spread evenly and allowed to dry in the shade at room temperature for about 2-3 weeks. The rind was turned occasionally to ensure uniform drying and to prevent fungal growth. Shade drying was preferred to preserve heat-sensitive phytochemicals and maintain the quality of bioactive compounds. Once the rind reached a constant weight, indicating adequate moisture removal, it was stored in airtight containers for further extraction and formulation work**.**

Fig.3 Dried kokum rind.

PREPARATION OF KOKUM RIND POWDER

After completion of the shade-drying process, the dried kokum rind was finely powdered using a mechanical grinder. The obtained powder was passed through a 60-mesh sieve to ensure a uniform particle size and to obtain a fine powder suitable for extraction and further formulation studies.

MACERATION EXTRACTION

Maceration is a conventional extraction technique in which dried and coarsely ground or powdered plant material is immersed in a suitable solvent at room temperature for a minimum of three days. The mixture is stirred or shaken periodically to improve the diffusion of phytoconstituents from the plant material into the solvent. After the extraction process was completed, the mixture was filtered through a fine mesh or sieve to separate the liquid extract from the plant material.

PROCEDURE

Dried *Garcinia indica* rind was cleaned and finely powdered, and 25 g of the powder was placed in an amber-coloured glass bottle. 250 mL of 70% ethanol was added at a 1:10 (w/v) ratio, and the mixture was thoroughly shaken. It was then macerated at 25–28 °C for 48

hours, with gentle shaking every 12 hours to enhance extraction. After maceration, the mixture was filtered through Whatman No. 1 filter paper, and the filtrate was collected as the ethanolic kokum rind extract.

4. PRELIMINARY PHYTOCHEMICAL SCREENING

The kokum extract was subjected to preliminary phytochemical screening to detect major phytoconstituents such as flavonoids, tannins, phenolics, carbohydrates, glycosides, anthocyanins, and hydroxycitric acid (HCA) using standard qualitative tests.

1. DETECTION OF TANNINS FERRIC CHLORIDE TEST

The kokum extract was treated with a few drops of ferric chloride solution. Formation of a blue-black or greenish colour confirmed the presence of tannins.

2. DETECTION OF FLAVONOIDS ALKALINE REAGENT TEST

A few drops of sodium hydroxide solution were added to the prepared kokum extract. The development of an intense yellow colour, which disappeared upon the addition of an acid, indicated the presence of flavonoids.

3. DETECTION OF CARBOHYDRATES MOLISCH'S TEST

About 2 mL of kokum extract was treated with a few drops of Molisch's reagent, followed by the careful addition of concentrated sulphuric acid along the side of the test tube. The formation of a violet ring at the interface indicated the presence of carbohydrates.

4. DETECTION OF HYDROXYCITRIC ACID CALCIUMCHLORIDE TEST

About 1ml of kokum extract was treated with a few drops of calcium chloride solution. The formation of a white precipitate indicated the presence of hydroxycitric acid.

5. DETECTION OF ANTHOCYANIN pH TEST

About 1ml of kokum extract was treated with a few drops of dilute hydrochloride acid. The development of a red or pink colour indicated the presence of anthocyanins.

5. FORMULATION OF PREBIOTIC BIOGEL

Table 1: Formulation of biogel.

PHASE	INGREDIENT	F1 50ml	F2 50ml
A (Gel Phase)	Carbopol 940	0.20g	0.20g
	Triethanolamine	q. s	q. s
B (Preservative Phase)	Methyl Paraben	0.05g	0.05g
	Propylene glycol	1.25ml	1.25ml
C (Active Phase)	Kokum Extract	2%	3%
	Inulin	0.75g	0.75g
	Niacinamide	1g	1g
	Aloevera gel	2.50g	2.50g
	Glycerin	1.25ml	1.25ml
	Vitamin E	1 drop	1 drop
	Distilled water	q. s	q. s

PREPARATION OF PREBIOTIC BIOGEL

1. GEL PHASE

Carbopol 940 was dispersed slowly in distilled water with continuous stirring and allowed to hydrate. Triethanolamine was added gradually to form a smooth gel.

2. PRESERVATIVE PHASE

Methyl paraben was dissolved in propylene glycol with gentle warming and incorporated into the prepared gel with continuous stirring.

3. ACTIVE PHASE

Kokum extract, inulin, niacinamide, aloe vera gel, glycerin, and vitamin E were mixed uniformly with the required quantity of distilled water to form a homogeneous active phase. This phase was slowly incorporated into the gel base with gentle stirring.

4. PACKING

The prepared biogel was stored in a clean, well-closed container until further evaluation.

6. EVALUTION PARAMETERS

1. APPEARANCE AND PHYSICAL CHARACTERISTICS

A small quantity of the prepared prebiotic biogel was taken in a clean glass container and examined visually under normal light. The formulation was evaluated for colour, odour, appearance, texture, consistency, homogeneity, and presence of lumps or foreign particles.

2. pH DETERMINATION

Disperse 1 g of biogel in 10 mL of distilled water and mix well. Calibrate the digital pH meter using standard buffers (pH 4 and 7). A skin-friendly formulation is generally around pH 4.5–6.5.

3. HOMOGENEITY

Take a small quantity of biogel and spread it between two glass slides. Examine for uniformity, lumps, grittiness, and visible particles. The formulation should be smooth and homogeneous.

4. SPREADABILITY

Place 0.5 g of biogel between two glass slides. Place a known weight on the upper slide and allow it to spread for a fixed time. Measure the diameter of the spread area. Greater spreading indicates better spreadability.

5. VISCOSITY

Determine the viscosity using a Brookfield viscometer at a suitable spindle and speed. Perform the test at room temperature.

6. STABILITY STUDY

Store the biogel under selected conditions such as room temperature and accelerated conditions. Examine periodically for changes in colour, odour, pH, viscosity and homogeneity.

7. IDENTIFICATION OF INULIN

Inulin in the biogel was qualitatively identified using Seliwanoff's test. The biogel sample was mixed with Seliwanoff's reagent and heated in a boiling water bath for 5–10 min. A cherry-red colour indicated the presence of inulin, owing to its hydrolysis to fructose under acidic conditions. An inulin standard and blank biogel were used as positive and negative controls, respectively.

7. RESULT AND DISCUSSION

a) FORMULATION

The formulation of prebiotic biogel involves in the use of rind extract of kokum as an active ingredient. The process involves preparation of preservative phase and active phase and

combining them to create the gel base. The final product is transferred into a suitable well-closed container.

Fig.4 Prebiotic Biogel.

b) EVALUATION

To verify the quality, safety and physiochemical to evaluate the parameters such as appearance, pH, homogeneity, spreadability, irritancy, viscosity, prebiotic and stability. To evaluate the biogel foe physical properties such as colour, odour, appearance, texture, consistency, homogeneity, and presence of lumps or foreign particles were measured. To make sure the biogel is safe to use without causing any redness, itching, irritation was examined. To make sure the biogel is compatible and has no negative effects on the skin.

c) PHYTOCHEMICAL ANALYSIS OF PREBIOTIC BIOGEL.

Table 2: phytochemical constituents.

S.NO	DESCRIPTION	RESULT (PRESENT/ ABSENT)
1.	Tannins	Present (+)
2.	Flavonoids	Present (+)
3.	Carbohydrates	Present (+)
4.	Hydroxycitric acid	Present (+)
5.	Anthocyanin	Present (+)

d) EVALUATION OF PREBIOTIC BIOGEL

Table 3: Physicochemical Parameters.

S. No	PARAMETERS	RESULT
1.	Appearance	Colour, clarity, physical appearance.
2.	Homogeneity	Uniformity of gel
3.	pH	Skin compatibility
4.	viscosity	Flow and consistency
5.	Spreadability	Easy of application
6.	Extrudability	Easy of removing gel from container
7.	Prebiotic test	Presence of prebiotic
8.	Stability study	Physical study during storage

e) TEST FOR IRRITANCY

Table 4: Irritancy Test.

S. No	PARAMETERS	RESULT
1.	Redness	Absent
2.	Itching	Absent
3.	Irritation	Absent

f) STABILITY EVALUATION

Table 5: Stability Test.

S. No	PARAMETERS	RESULT
1.	Colour	Stable
2.	Odour	Stable
3.	Appearance	Stable
4.	Viscosity	Stable
5.	Spreadability	Stable

g) IDENTIFICATION OF INULIN

The biogel formulation produced a distinct cherry-red coloration upon treatment with Seliwanoff's reagent and heating, indicating the presence of inulin. This color development occurs because inulin is hydrolyzed under acidic conditions to release fructose, which reacts with resorcinol in Seliwanoff's reagent. The blank biogel showed no cherry-red coloration, whereas the inulin standard produced a similar positive response.

Fig.5 Inulin Test.

8. CONCLUSION

The present study focused on the development of a prebiotic biogel incorporating Garcinia indica (kokum) rind extract along with inulin, aloe vera gel, niacinamide, glycerin, vitamin E, and Carbopol 940. The ethanolic kokum rind extract was prepared by maceration and subjected to preliminary phytochemical screening, which indicated the presence of important phytoconstituents including flavonoids, tannins, carbohydrates, anthocyanins, and hydroxycitric acid. The formulated biogel combines the potential antioxidant, moisturizing,

skin-conditioning, and anti-ageing properties of kokum with the prebiotic action of inulin and the soothing and hydrating properties of aloe vera. The developed formulation is intended to support skin hydration, skin barrier health, and a balanced skin microbiome while providing a convenient topical dosage form. Evaluation of appearance, pH, homogeneity, spreadability, viscosity, and stability can be used to assess the quality and suitability of the formulation. Overall, the kokum-based prebiotic biogel shows promising potential as a natural topical skincare formulation. Further studies involving quantitative phytochemical analysis, microbiome-related studies, long-term stability testing, safety evaluation, and clinical assessment are required to establish its efficacy and safety for practical cosmetic and dermatological applications.

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