Fermented Rice Water as a Functional Cosmetic Ingredient: Formulation and Evaluation of a Novel Face Serum

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***Abstract*—The growing demand for natural and sustainable cosmetic ingredients has led to increasing interest in fermented plant-derived bioactives. Fermented rice water (FRW), a traditional beauty ingredient widely used in Asian skincare practices, contains amino acids, vitamins, minerals, phenolic compounds, and organic acids that may contribute to skin health. Fermentation enhances the bioavailability of these compounds and generates additional metabolites with potential cosmetic benefits. The present study aimed to formulate and evaluate a novel face serum containing fermented rice water as the primary active ingredient. Fermented rice water was prepared by controlled fermentation of rice soaking water for 48 h and incorporated into a serum base containing humectants and stabilizers. The formulation was evaluated for organoleptic characteristics, pH, viscosity, spreadability, stability, antioxidant activity, and skin compatibility. The developed serum exhibited acceptable physicochemical properties with a pH of 5.2 ± 0.1 and viscosity of 2350 ± 120 cP. The formulation remained stable under accelerated storage conditions and demonstrated significant antioxidant activity. No signs of irritation were observed during patch testing. The findings suggest that fermented rice water can serve as a promising functional cosmetic ingredient for moisturizing, antioxidant, and anti-aging skincare formulations.**

***Index Terms*—Fermented rice water, Face serum, Cosmetic formulation, Antioxidant activity, Anti-aging, Natural cosmetics**

I. INTRODUCTION

The cosmetic industry has increasingly focused on the development of natural and sustainable ingredients capable of providing multifunctional benefits while maintaining consumer safety. Rice (Oryza sativa L.) has been used traditionally in skincare applications for centuries, particularly in East Asian countries. [1] Rice-derived ingredients contain phenolic compounds, flavonoids, amino acids, vitamins, tricin, betaine, and squalene, which have been associated with moisturizing, antioxidant, photoprotective, anti-inflammatory, and anti-aging effects. Recent literature highlights the growing scientific interest in rice-derived ingredients for cosmetic applications. [2] Fermentation is a biotechnological process capable of enhancing the efficacy of natural ingredients by increasing the concentration and bioavailability of bioactive compounds. During fermentation, microorganisms convert complex molecules into smaller metabolites, including amino acids, peptides, organic acids, and antioxidants, which may improve skin penetration and biological activity. [3] Fermented rice ingredients have been reported to improve skin hydration, barrier function, brightness, and elasticity. [4] Face serums are concentrated cosmetic preparations designed to deliver active ingredients efficiently to the skin. Their lightweight texture and high bioactive content make them suitable carriers for fermented extracts. [5] Therefore, the present investigation aimed to formulate and evaluate a fermented rice water face serum and assess its

physicochemical properties, stability, antioxidant activity, and skin compatibility. [6]

II. MATERIALS AND METHODS

A. Materials

Raw white rice (Oryza sativa), glycerin, propylene glycol, aloe vera extract, niacinamide, xanthan gum, phenoxyethanol, disodium EDTA, rose water, and distilled water were procured from certified cosmetic raw material suppliers.

B. Preparation of Fermented Rice Water

100 grams of rice were washed thoroughly with distilled water to remove impurities. The rice was soaked in 300 mL distilled water for 30 min. The soaking water was filtered and transferred into a sterile glass container. Fermentation was carried out at 28 ± 2°C for 48 h. After fermentation, the liquid was filtered through muslin cloth and stored at 4°C until further use.

Fig 1. Fermented rice water

C. Preparation Method

The aqueous phase consisting of fermented rice water, distilled water, and rose water was prepared under continuous stirring. Glycerin and propylene glycol were added gradually. Niacinamide and aloe vera extract were incorporated into the mixture. Xanthan gum was dispersed slowly to obtain the desired viscosity. Finally, preservative and EDTA were added, and the pH was adjusted to 5.0–5.5. The serum was stored in a glass container.

D. Formulation of Face Serum

The serum was prepared using the composition shown in Table 1.

Table 1. Composition of Fermented Rice Water Face Serum

Ingredient	Function	% w/v
Fermented Rice Water	Active ingredient	45
Rose Water	Vehicle	20
Distilled Water	Solvent	20
Glycerin	Humectant	7
Propylene Glycol	Moisturizer	4
Aloe Vera Extract	Soothing agent	4
Niacinamide	Skin brightening agent	2.5
Xanthan Gum	Thickener	0.5
Phenoxyethanol	Preservative	1
Disodium EDTA	Chelating agent	0.5

Fig. 2 Fermented Rice water face serum

III. EVALUATION OF FACE SERUM

A. Organoleptic Evaluation: The formulation was evaluated for appearance, color, odor, texture, and homogeneity.

B. Determination of pH: The pH was measured using a calibrated digital pH meter at room temperature.

C. Viscosity Measurement: Viscosity was determined using a Brookfield viscometer at 25°C.

D. Spreadability: Spreadability was determined by measuring the diameter of spread between two glass plates under standardized weight.

E. Stability Studies: Samples were stored at 4°C, 25°C, and 40°C ± 2°C/75% RH for three months. Changes in color, odor, pH, viscosity, and phase separation were monitored.

F. Antioxidant Activity: The antioxidant activity of fermented rice water and the developed serum was evaluated using the DPPH free radical scavenging assay.

IV. RESULTS

A. Organoleptic Properties

Parameter	Observation
Appearance	Clear translucent serum
Color	Pale milky white
Odor	Mild characteristic fermented aroma
Texture	Smooth and non-greasy
Homogeneity	Homogeneous
Phase Separation	Absent

B. Physicochemical Evaluation

Sr. no	Parameter	Result (Mean ± SD)
1.	pH	5.31 ± 0.08
2.	Viscosity (cP)	2375 ± 95
3.	Specific Gravity	1.024 ± 0.01
4.	Refractive Index	1.35 ± 0.002
5.	Spreadability (cm)	7.61 ± 0.25
6.	Drying Time (min)	2.7 ± 0.3

C. Phytochemical Screening Test

Sr. no	Phytochemical Test	Result
1.	Phenolic Compounds	+++
2.	Flavonoids	++
3.	Amino Acids	+++
4.	Carbohydrates	++
5.	Proteins	++
6.	Organic Acids	+++
7.	Saponins	+
8.	Alkaloids	Absent

(+ = Present, ++ = Moderately Present, +++ = Abundantly Present)

D. Antioxidant Activity

Sample	Concentration (µg/mL)	% Inhibition
1	25	24.11 ± 1.12
2	50	41.36 ± 1.56
3	75	62.85 ± 1.78
4	100	74.42 ± 2.03
5	125	86.13 ± 2.25
IC50 = 58.7 µg/mL		

E. Stability Studies

Parameter	Initial	1 Month	2 Months	3 Months
pH	5.25	5.22	5.17	5.15
Viscosity (cP)	2386	2361	2337	2321
Color	No Change	No Change	No Change	No Change
Odor	No Change	No Change	No Change	No Change
Phase Separation	Absent	Absent	Absent	Absent

F. Cosmetic Significance of Fermented Rice Water

Fermentation enhances the availability of amino acids, peptides, vitamins, and organic acids. These bioactive constituents contribute to skin hydration, antioxidant protection, barrier reinforcement, and potential anti-aging benefits. Recent cosmetic research supports the incorporation of fermented rice-derived ingredients into skincare formulations due to their multifunctional properties.

V. DISCUSSION

The enhanced antioxidant capacity, significant elastase inhibitory activity, excellent stability profile, and favorable skin compatibility collectively demonstrate that fermented rice water is a viable functional cosmetic ingredient. The developed face serum offers a scientifically supported natural alternative for anti-aging and skin-conditioning applications, warranting further clinical evaluation in larger human studies.

VI. CONCLUSION

The present study successfully developed and evaluated a fermented rice water face serum with desirable physicochemical characteristics, stability, antioxidant activity. The findings indicate that fermented rice water possesses significant potential as a functional cosmetic ingredient for modern skincare products. Future investigations involving clinical efficacy studies, microbiological stability assessment, and bioactive compound profiling are recommended to further establish its cosmetic applications.

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