



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Research Article

Formulation and Evaluation of Herbal Face Serums as a Cosmeceutical Applications

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ARTICLE INFO

Published: 18 Jun 2026

Keywords:

Herbal face serums,
Cosmeceuticals,
Antioxidants, Anti-aging,
Skin hydration,
Spreadability.

DOI:

10.5281/zenodo.20751792

ABSTRACT

Herbal face serums have gained considerable attention due to their lightweight texture, rapid absorption, and ability to deliver bioactive compounds effectively into the skin. The present study aimed to formulate and evaluate herbal face serums using natural ingredients such as aloe vera, licorice, green tea, guava, orange peel, carrot, amla, cucumber, and essential oils. Eight formulations were prepared using oil-in-water and dual-phase emulsion systems and evaluated for physicochemical parameters including pH, texture, spreadability, washability, irritability, homogeneity, and phase separation. The formulations exhibited acceptable skin-friendly pH, smooth texture, good spreadability, and satisfactory washability. Most formulations showed good stability and were non-irritating upon topical application. Among all formulations, S7 with orange peel extract, demonstrated superior stability and spreadability, indicating better overall performance. The findings suggest that herbal face serums formulated with natural bioactive ingredients can serve as safe, effective, and multifunctional skincare products with potential applications in cosmetic and cosmeceutical formulations.

INTRODUCTION

Skin is the largest organ of the human body and serves as the first protective barrier against environmental pollutants, microorganisms, harmful chemicals, and ultraviolet radiation. Continuous exposure to dust, pollution, stress, sunlight, and chemical-based cosmetic products can damage the skin and lead to various problems

such as dryness, acne, hyperpigmentation, premature aging, wrinkles, and dullness. [1,2]

Today, consumers are increasingly aware of skincare needs and are increasingly preferring herbal cosmetic products because of their natural origin and reduced side effects. Herbal ingredients are rich in vitamins, antioxidants, minerals, and bioactive compounds that help nourish and protect

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



the skin naturally. Ingredients such as aloe vera, licorice, green tea, cucumber, amla, guava, and essential oils are widely used in cosmetic formulations due to their moisturizing, soothing, anti-inflammatory, anti-aging, and skin-brightening properties. [3,4,5]

A face serum is a lightweight skincare product formulated to deliver active ingredients efficiently into the skin. Unlike heavy creams, serums are lightweight and easily absorbed, making them highly effective in improving skin hydration, elasticity, smoothness, and radiance. They are commonly used for moisturizing, anti-aging, acne control, brightening, and skin rejuvenation. [2,6,7]

Herbal face serums combine the benefits of natural ingredients with advanced cosmetic technology to provide multifunctional skincare benefits. This study focuses on the formulation and evaluation of different herbal face serum formulations prepared using natural plant extracts and oils as they are proven safe and are being used as home remedies. [8,9,10,11,12]

Types of Serums:

Hydrating Serums

Hydrating serums are formulated to improve the moisture content of the skin. Ingredients such as glycerin and hyaluronic acid help attract and retain moisture, making these serums suitable for dry and dehydrated skin.

Anti-Aging Serums

Anti-aging serums help reduce signs of aging such as wrinkles, fine lines, and sagging skin. They usually contain antioxidants, vitamins, peptides, and herbal extracts that promote collagen production and improve skin elasticity.

Brightening Serums

Brightening serums are used to improve skin tone and reduce pigmentation, dark spots, and dullness. Ingredients like licorice, vitamin C, orange peel, and niacinamide help provide a radiant and glowing complexion.

Acne-Fighting Serums

These serums help control acne, pimples, and excess oil production. Ingredients such as salicylic acid, tea tree oil, and green tea extract help reduce inflammation and prevent bacterial growth.

Calming Serums

Calming serums are beneficial for sensitive and irritated skin. Herbal ingredients such as aloe vera, cucumber, chamomile, and green tea help soothe redness and skin irritation.

Exfoliating Serums

Exfoliating serums contain ingredients that help remove dead skin cells and promote skin renewal. These serums improve skin texture and brightness.

Firming Serums

Firming serums help improve skin elasticity and tighten loose skin. They are commonly used for mature skin to reduce sagging and improve firmness.

Oil-Control Serums

Oil-control serums help regulate sebum production and reduce excessive oiliness without causing dryness. They are suitable for oily and combination skin types.

ADVANTAGES OF FACE SERUM:

Face serums have several advantages, making them a popular choice in skincare routines. Here are some key benefits:



- Face serums contain a high concentration of active ingredients.
- They are lightweight and quickly absorbed into the skin.
- They help improve skin hydration and moisture retention.
- Serums reduce signs of aging such as wrinkles and fine lines.
- They help brighten the skin and reduce pigmentation.
- Serums penetrate deeper into the skin compared to creams.
- Herbal serums generally produce fewer side effects.
- They provide multifunctional skincare benefits such as moisturizing, anti-aging, and rejuvenation.

DISADVANTAGES OF FACE SERUM

Face serums can be great for targeting specific skin concerns, but there are a few potential downsides to consider:

- Some active ingredients may cause irritation in sensitive individuals.
- Certain herbal formulations may show phase separation or stability issues.
- Preservatives are often required to prevent microbial contamination.
- Overuse may lead to dryness or redness.
- Natural ingredients may reduce product shelf life.
- Highly concentrated formulations may not suit extremely sensitive skin.

MATERIALS AND METHODS

The materials used in the study were represented as tabular form in table 1, for their composition and use in serum along with their biological or chemical names. Many of them were used as age old home made remedies and proven tested as safe.

Table 1: List of Materials Used Along with Category and Function

Ingredient	Biological / Chemical Name	Brief Composition	Use in Serum
Aloe vera	Aloe barbadensis Miller	Rich in polysaccharides, vitamins, enzymes, amino acids	Hydrates, soothes irritation, promotes healing
Lemon oil	Citrus limon	Contains limonene, citral, flavonoids	Brightening, antioxidant, refreshing fragrance
Castor oil	Ricinus communis	Rich in ricinoleic acid	Moisturizes and improves skin softness
Coconut oil	Cocos nucifera	Contains medium-chain fatty acids	Emollient, prevents moisture loss
Tween 20	Polysorbate 20	Non-ionic surfactant/emulsifier	Helps mix oil and water phases
Jasmine oil	Jasminum officinale	Essential oil with aromatic esters	Fragrance, calming and soothing effect
Glycerine	Glycerol	Trihydric alcohol	Humectant that attracts moisture
Rose water	Rosa damascena distillate	Floral water containing phenolics	Cooling, soothing, toner effect



Olive oil	Olea europaea	Rich in oleic acid and antioxidants	Nourishes and softens skin
Sandalwood oil	Santalum album	Contains santalol compounds	Anti-inflammatory, fragrance
Liquorice extract	Glycyrrhiza glabra	Glycyrrhizin, flavonoids	Reduces pigmentation and inflammation
Rose oil	Rosa damascena oil	Aromatic terpenes and alcohols	Fragrance, calming, antioxidant
Carrot extract	Daucus carota	Beta-carotene, vitamins A & C	Anti-aging and skin rejuvenation
Amla extract	Phyllanthus emblica	Rich in vitamin C and tannins	Antioxidant and skin brightening
Ethanol	Ethyl alcohol	Organic solvent	Extraction solvent and preservative aid
Green tea extract	Camellia sinensis	Polyphenols, catechins	Antioxidant and anti-aging
Cucumber juice	Cucumis sativus	Water, silica, vitamins	Cooling and hydrating
Salicylic acid	Salicylic acid	Beta-hydroxy acid (BHA)	Acne control and exfoliation
Sodium benzoate	Sodium benzoate	Preservative salt	Prevents microbial growth
Citric acid	Citric acid	Organic acid from citrus	pH adjustment and mild exfoliation
Propylene glycol	Propane-1,2-diol	Synthetic humectant	Solvent and moisture retention
Banana leaf extract	Musa paradisiaca	Polyphenols and antioxidants	Moisturizing and rejuvenating
Jojoba oil	Simmondsia chinensis	Liquid wax esters	Balances sebum and moisturizes
Orange peel extract	Citrus sinensis	Vitamin C, flavonoids	Brightening and antioxidant
Guava fruit extract	Psidium guajava	Vitamin C, lycopene, flavonoids	Anti-aging and antioxidant
Almond oil	Prunus Amygdalus	Fatty acids, vitamin E	Nourishing and softening
Methyl paraben	Methyl Para hydroxybenzoate	Preservative compound	Prevents fungal and bacterial contamination

FORMULATION OF HERBAL FACE SERUMS Working formula:

SERUM 1 FORMULATION:

Serum 1 was formulated using Aloe vera gel, lemon oil, castor oil, coconut oil, and jasmine oil to provide moisturizing, antioxidant, soothing, and skin-brightening effects. The formulation was designed as a lightweight herbal serum with enhanced hydration and nourishment properties.

INGREDIENTS	QUANTITY (30 ml)
Lemon oil, ml	5
Aloe vera gel, ml	5
Castor oil, ml	1.8
Coconut oil, ml	5
Tween 20, ml	0.4
Rose water, ml	0.02
Glycerine, ml	0.2
Jasmine oil, ml	0.02
Distilled water, ml	q.s. up to 30



The formulation combines natural oils and herbal ingredients that help improve skin softness, hydration, and overall skin appearance while providing antioxidant protection [8,10]

SERUM 2 FORMULATION:

Serum 2 was prepared using Aloe vera gel, jojoba oil, sandalwood oil, and glycerine to obtain a soothing and moisturizing herbal serum suitable for dry and sensitive skin.

Working formula:

INGREDIENTS	QUANTITY (30ml)
Aloe vera gel, ml	10
Jojoba oil, ml	1.8
Sandalwood oil, ml	0.02
Glycerine, ml	5
Coconut oil, ml	0.4
Tween 20, ml	0.2
Distilled water, ml	q.s up to 30

The selected ingredients provide skin nourishment, hydration, and calming effects, making the formulation suitable for maintaining healthy and soft skin. [6,9]

SERUM 3 FORMULATION:

Serum 3 was formulated using Aloe vera gel, licorice extract, lemon oil, and coconut oil to develop a herbal serum with anti-hyperpigmentation, antioxidant, and skin-brightening properties.

Working formula:

INGREDIENTS	QUANTITY (100ml)
Aloe vera gel, ml	65
Licorice extract, ml	30
Lemon oil, ml	1.0
Coconut oil, ml	0.5
Glycerine, ml	1.0
Tween 20, ml	2
Rose oil, ml	0.02
Distilled water, ml	q.s up to 100

The formulation contains active herbal ingredients that help reduce pigmentation, improve skin radiance, and provide antioxidant protection against environmental damage. [13,14]

SERUM 4 FORMULATION:

Serum 4 was prepared using carrot extract, amla extract, olive oil, and sandalwood oil to obtain a serum rich in antioxidants and vitamins for anti-aging and skin rejuvenation purposes.

Working formula:

INGREDIENTS	QUANTITY (30ml)
Extract of carrot, ml	5
Extract of amla, ml	5
Ethanol, ml	100
Olive oil, ml	1.8
Sandalwood oil, ml	0.02
Glycerine, ml	5
Coconut oil, ml	0.4
Tween 20, ml	0.2
Distilled water, ml	q.s up to 30

The formulation provides antioxidant and nourishing effects that help improve skin texture, brightness, and overall skin rejuvenation. [15,9]

SERUM 5 FORMULATION:

Serum 5 was formulated using green tea extract, Aloe vera juice, cucumber juice, and salicylic acid to develop a refreshing serum with antioxidant, cooling, and anti-acne properties.

Working formula:

INGREDIENTS	QUANTITY (50ml)
Green tea extract, ml	3.5
Aloe vera juice, ml	3.5
Cucumber juice, ml	3.5
Rose water, ml	20
Salicylic acid, g	0.5
Sodium benzoate, g	0.5
Citric acid, g	0.02
Propylene glycol, ml	2
Ethanol, ml	4



Glycerine, ml	8
Distilled water, ml	q.s up to 50

The ingredients present in the formulation help soothe the skin, reduce acne, control excess oil, and provide hydration and antioxidant protection. [15,20]

SERUM 6 FORMULATION:

Serum 6 was prepared using banana leaf extract, jojoba oil, rose oil, and sandalwood oil to formulate a nourishing herbal serum with moisturizing and rejuvenating properties

Working formula:

INGREDIENTS	QUANTITY (30ml)
Banana leaf extract, ml	4
Jojoba oil, ml	4
Rose oil, ml	1
Sandalwood oil, ml	1
Rose water, ml	2
Tween 20, ml	0.8
Glycerin, ml	5
Distilled water, ml	q.s up to 30

The formulation provides skin hydration, nourishment, and soothing effects while improving skin texture and softness.[16]

SERUM 7 FORMULATION:

Serum 7 was formulated using orange peel extract, Aloe vera gel, rose water, and glycerine to prepare an herbal serum with skin-brightening and moisturizing properties.

Working formula:

INGREDIENTS	QUANTITY (100ml)
Orange peel extract, ml	30
Aloe vera gel, ml	40
Rose water, ml	20
Glycerin, ml	10

The formulation exhibited good moisturizing and antioxidant properties, helping improve skin brightness and overall appearance. [17,10]

SERUM 8 FORMULATION:

Serum 8 was prepared using guava fruit extract, almond oil, Aloe vera gel, and sandalwood oil to obtain a nourishing herbal serum with antioxidant and anti-aging activity.

Working formula:

INGREDIENTS	QUANTITY (50 ml)
Guava fruit extract, ml	25
Almond oil, ml	100
Aloe vera gel, ml	5
Methyl paraben, g	0.1
Glycerin, ml	12.5
Sandalwood oil, ml	2
Olive oil, ml	2
Tween 20, ml	4
Rose water, ml	q.s up to 50

The formulation contains antioxidant-rich herbal ingredients that help improve skin nourishment, hydration, and protection against premature aging. [18,19]

PREPARATION OF FACE SERUM:

The herbal face serum formulations were prepared by the trituration method. Initially, the oil phase containing ingredients like oils, essential oils, and emulsifying agents was prepared separately by continuous mixing.

At the same time, the aqueous phase containing ingredients like aloe vera gel, herbal extracts, glycerin, rose water, cucumber juice, and distilled water was prepared separately with continuous stirring until a homogeneous mixture was obtained.

The oil phase was then added slowly into the aqueous phase with continuous trituration to form



a primary emulsion. The remaining aqueous phase was added gradually while stirring continuously to obtain a smooth and homogeneous serum formulation.

Plant extracts such as licorice, guava, orange peel, carrot, banana leaf, and amla were prepared by maceration using suitable solvents followed by filtration before incorporation into the formulation. Finally, the prepared formulations were transferred into airtight containers and stored at room temperature for further evaluation.

EVALUATION OF SERUM FORMULATIONS:

The prepared herbal face serum formulations were evaluated using various physicochemical and performance parameters to determine their quality, stability, safety, and suitability for skin application. The evaluation procedures are described below.

1. Organoleptic Evaluation (colour, odour, appearance)

The prepared serum formulations were visually examined for their colour, odour, appearance, and overall acceptability. A small quantity of each serum was taken in a transparent container and observed under normal daylight conditions. The characteristic fragrance of the serum was also noted. This evaluation helped determine the aesthetic appeal and consumer acceptability of the formulations. [6,8,9]

2. Texture Evaluation

The texture of each serum was evaluated by applying a small amount onto the skin and gently rubbing it between the fingers. The formulations were examined for smoothness, consistency, stickiness, and ease of application. A good serum should possess a smooth and pleasant texture

without leaving an excessively greasy residue. [6,10,11]

3. Determination of pH

The pH of the formulations was measured using a calibrated digital pH meter. Approximately 1 g of serum was dispersed in 10 mL of distilled water, and the electrode was immersed in the sample. The pH value was recorded after stabilization. Maintaining a pH close to that of the skin is essential to avoid irritation and ensure user comfort. [8,13,24]

4. Spreadability Test

Spreadability was determined to assess the ease with which the serum could be applied to the skin. A known quantity of serum was placed between two glass slides, and a standard weight was applied over the upper slide. After 2 min, the diameter or area of spread was measured and recorded. Higher spreadability indicates better ease of application and uniform distribution on the skin surface. [9,10,21]

5. Washability Test

Washability was evaluated by applying a small amount of serum onto the skin and subsequently washing the area with water. The ease with which the formulation could be removed was observed. The formulations were considered satisfactory if they could be washed off easily without leaving excessive residue. [8,13,24]

6. Irritability Test

A skin patch test was performed to evaluate the safety of the serum formulations. A small quantity of serum was applied to a limited area of skin, usually on the forearm, and observed for 24 hours. Any signs of redness, itching, swelling, burning sensation, or allergic reaction were noted. The



absence of such reactions indicated that the formulation was non-irritating and safe for topical use. [9,13,20]

7. Phase Separation Study

The physical stability of the formulations was assessed by observing them for any signs of phase separation during storage. The serum samples were stored in suitable containers at room temperature and examined periodically. The appearance of separate oil and aqueous layers indicated instability, whereas formulations showing no phase separation were considered physically stable. [6,10,22]

8. Homogeneity Evaluation

The homogeneity of the formulations was assessed through visual inspection. Each serum was examined for uniformity, smoothness, and the absence of lumps or coarse particles. A homogeneous formulation indicates proper mixing and uniform distribution of ingredients throughout the serum. [9,11,21]

9. Stability Study

The prepared formulations were subjected to stability testing at room temperature ranging from 25 to 35°C on bench top away from direct sunlight. The stored samples were observed periodically for changes in colour, odour, texture, pH, and phase separation for 1 month. The stability study helped determine the ability of the serums on bench top to maintain their quality and effectiveness during storage. [6,8,10,22]

10. Skin Compatibility Evaluation

The compatibility of the serum with the skin was assessed through topical application. The formulations were applied to the skin and monitored for comfort, hydration, smoothness, and any adverse reactions. This evaluation confirmed the suitability of the serum for routine skincare use. [2,13,20]

11. Microbial contamination Test

The mixed culture was obtained from 1 gm of leaf litter compost pile and serially diluted directly in tubes of 20 ml liquid agar medium. The sterile nutrient agar medium, 20 ml, was maintained in a liquid state at a temperature of 45°C and mixed well with 1 ml of mixed culture to allow thorough distribution of the inoculum. The inoculated agar medium was transferred into sterile petri plates, allowed to solidify and incubated as a positive standard. In a negative control test 1 ml of sterile water mixed in 20 ml of sterile nutrient agar medium at 45°C was transferred into sterile petri plates and allowed to solidify. 1 ml of test serum formulation mixed in 20 ml of nutrient agar medium at 45°C. The nutrient agar medium was shaken and poured in a sterile petri plate, cooled to solidify and incubated at 37°C for 24 hours. [8,10,20]

RESULTS AND DISCUSSIONS:

The prepared serum formulations were evaluated for various physicochemical parameters such as color, odor, texture, washability, irritability, phase separation, pH, and spreadability and performance characteristics. The evaluation results of formulations S1–S4 were presented in Table No. 2

Table No. 2: Evaluation results data of Herbal Serums (S1–S4)

Serum no.	S1	S2	S3	S4
Colour	Milky yellow	Pale yellow	Light brown	Transparent
Odor	Citrusy fragrance	Rose fragrance	Earthy liquorice fragrance	Sandalwood fragrance



Texture	Smooth liquid	Homogenous, transparent liquid	Homogenous, smooth liquid	Smooth liquid
Washability	Easily washable	Easily washable	Easily washable	Easily washable
Irritability	Non-irritant	Non-irritant	Non-irritant	Non-irritant
Phase separation	Yes	No	No	Yes
pH	5.2	6.1	7.0	5.1
Spreadability, cm ²	3.14	2.11	3.97	2.98
Bench top stability	Unstable	Stable	Stable	Unstable

Formulations S2 and S3 showed better homogeneity and absence of phase separation compared to S1 and S4. All formulations exhibited suitable pH and non-irritant characteristics for topical application.

Further evaluation of formulations S5–S8 was carried out to determine their physical stability, spreadability, washability, and skin compatibility.

The results obtained are shown in Table No. 3

Table No. 3: Evaluation of Herbal Dual-Phase Face Serum (S5–S8)

Serum no.	S5	S6	S7	S8
Colour	Transparent	Dark green	Mustard yellow	Orange
Odor	Rosy fragrance	Rosy fragrance	Orange fragrance	Rosy fragrance
Texture	Homogenous, smooth	Smooth texture	Smooth texture on skin	Smooth liquid
Washability	Easily washable	Easily washable	Easily washable	Easily washable
Irritability	Slight irritation	Non-irritant	Non-irritant	Non-irritant
Phase separation	No	Yes	No	Yes
pH	6.0	5.8	5.1	5.6
Spread ability, cm ²	3.93	5.8	6.6	4.9
Bench top stability	Stable	Unstable	Stable	Unstable

Among the formulations, S7 showed maximum spreadability and satisfactory physicochemical properties without irritation or phase separation, indicating better formulation stability and performance.

The formulation wise observations of evaluation test data was summarized below:

- Serum 1 prepared using lemon oil, coconut oil, castor oil, aloe vera gel, glycerine, and jasmine oil, showed a smooth texture with a pleasant citrus fragrance. The formulation had a skin-friendly pH and spread easily on the skin. However, phase separation was noticed, which may be due to the higher oil content and lower amount of emulsifier used. Even with this limitation, the serum was non-irritating and easy to wash off, making it suitable for topical application.
- Serum 2 contained aloe vera gel, olive oil, sandalwood oil, glycerine, and coconut oil. It formed a clear and homogenous serum with a mild rose fragrance and suitable pH for skin use. No phase separation was observed. Although the spreadability was slightly lower compared to other formulations, the serum remained smooth, non-irritating, and easy to wash.
- Serum 3 was formulated using liquorice extract, aloe vera gel, lemon oil, and coconut oil. The serum appeared light brown with



an earthy liquorice odour. Among the first three formulations, it showed the best stability with no phase separation and a neutral pH. The serum also showed good spreadability, smooth texture, and a non-irritant nature.

- Serum 4, containing carrot extract, amla extract, olive oil, and sandalwood oil, showed a transparent appearance with a sandalwood fragrance. The serum had a smooth texture and acceptable spreadability. However, phase separation was observed, indicating that the emulsion system was not stable, possibly due to the lower emulsifying agent. The formulation remained non-irritating and easy to wash from the skin.
- Serum 5 was prepared using green tea extract, cucumber juice, aloe vera juice, salicylic acid, and rose water. It formed a smooth and transparent serum with a rosy fragrance and good spreadability. Slight irritation was observed. Even so, the formulation remained stable without phase separation, showing good uniformity and consistency.
- Serum 6 contained banana leaf extract, jojoba oil, rose oil, and sandalwood oil. The serum had a dark green appearance with a smooth texture. It spreads easily on the skin. Although the serum was non-irritating and maintained a skin-friendly pH, phase separation was observed.
- Serum 7, formulated with orange peel extract, aloe vera gel, rose water, and glycerine, the formulation remained stable without phase separation and maintained a suitable pH for skin application. It was also non-irritating, smooth on application, and easy to wash, indicating stability.

- Serum 8 was prepared using guava fruit extract, almond oil, aloe vera gel, glycerine, and sandalwood oil. The formulation produced a smooth, orange-coloured serum with a pleasant rosy fragrance. It showed good spreadability and a suitable pH. Although phase separation was observed, it was smooth, non-irritating, and easily washable.

CONCLUSIONS

Overall, all formulations with natural herbal ingredients can be used to prepare safe, effective, and skin-friendly face serums with suitable changes. But Serum 7 showed good overall performance and was suitable for skin application. Serum 7 showed better stability and spreadability, mainly due to the presence of orange peel extract, which may contain pectin that helped to provide beneficial effects. This formulation, S7 was free from microbes because they do not show any zone of growth, during inoculation in the agar medium whereas the positive control showed the colonies. Hence, the microbial contamination test indicates no microbial presence or microbial growth in the serum S7. The further evaluations are required for long term storage and commercial viability.

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HOW TO CITE: Induru Jagadeesh, Amrutha Karri, Harshitha Mallela, Shreyanjali Mareddy, Suhana Khatoon, Formulation and Evaluation of Herbal Face Serums as a Cosmeceutical Applications, *Int. J. of Pharm. Sci.*, 2026, Vol 4, Issue 6, 4725-4736. <https://doi.org/10.5281/zenodo.20751792>

