Formulation and Evaluation of Rosemary Leaf Powder and Licorice Root Powder-Based Herbal Shampoo Powder for Hair Strengthening, Scalp Protection, and Dandruff Control

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***Abstract*—The present study aims to formulate a novel herbal shampoo powder containing Rosemary (Rosmarinus officinalis) leaf powder and Licorice (Glycyrrhiza glabra) root powder as primary active ingredients. Rosemary is traditionally used for scalp stimulation and hair strengthening, while licorice contains saponins, flavonoids, and glycyrrhizin that provide cleansing, soothing, and anti-inflammatory effects. Previous studies have demonstrated the successful formulation of licorice-based shampoos and polyherbal shampoo powders, supporting the feasibility of this approach**

I. INTRODUCTION

Hair is an important part of personal appearance and scalp health. Modern shampoos commonly contain synthetic surfactants such as sodium lauryl sulfate (SLS), parabens, silicones, and artificial fragrances that may cause scalp irritation, dryness, and hair damage upon prolonged use. Herbal powder shampoos are gaining popularity because they are biodegradable, eco-friendly, and free from harsh chemicals.

Rosemary (Rosmarinus officinalis) contains rosmarinic acid, carnosic acid, flavonoids, and essential oils that stimulate scalp circulation and support healthy hair growth. Licorice (Glycyrrhiza glabra) contains glycyrrhizin, liquiritin, flavonoids, and saponins which possess anti-inflammatory, antimicrobial, and soothing properties.

The combination of rosemary and licorice in a waterless powder shampoo formulation may provide cleansing, conditioning, dandruff control, and scalp protection while minimizing the use of synthetic ingredients.

II. OBJECTIVES

1. To formulate a stable herbal powder shampoo.
2. To incorporate rosemary and licorice as primary active ingredients.
3. To evaluate physicochemical and performance characteristics.
4. To determine anti-dandruff and conditioning properties.
5. To assess stability under different storage conditions

III. TYPES OF SHAMPOO

Regular Shampoo – Cleans hair and scalp for everyday use.
Clarifying Shampoo – Removes excess oil, dirt, and product buildup.
Medicated Shampoo – Treats scalp conditions like dandruff and itching.
Moisturizing Shampoo – Adds moisture to dry and damaged hair.
Volumizing Shampoo – Makes thin hair appear fuller and thicker.

Color-Protecting Shampoo – Helps maintain dyed hair color.
Baby Shampoo – Mild and gentle, causes less eye irritation.
Dry Shampoo – Absorbs oil without using water.
Anti-Dandruff Shampoo – Controls dandruff and scalp flaking.
Herbal/Natural Shampoo – Contains plant-based ingredients for gentle cleansing.
Anatomy of Hair

IV. PARTS OF HAIRS

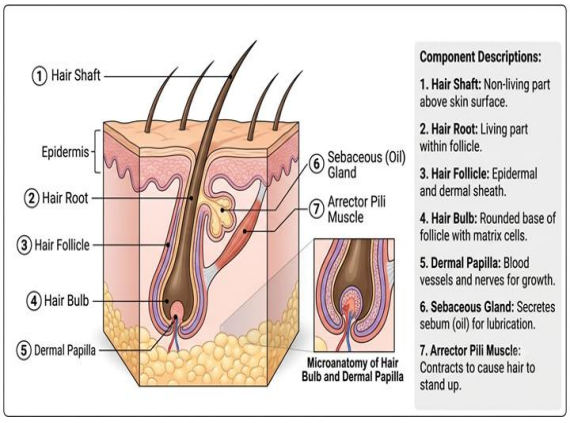

FIG: -1 PARTS OF HAIRS

1. Hair Shaft
The hair shaft is the visible portion of hair that projects above the skin surface. It is made of dead keratinized cells and consists of three layers: cuticle, cortex, and medulla.

2. Hair Root
The hair root is the part of the hair located beneath the skin inside the follicle. It anchors the hair and receives nourishment for growth.

3. Hair Follicle
The hair follicle is a tube-like structure in the skin that surrounds the hair root. It is responsible for hair formation, growth, and anchorage.

4. Hair Bulb
The hair bulb is the enlarged,
rounded base of the hair root.
It contains actively dividing cells that produce new hair.

5. Dermal Papilla
The dermal papilla is a small projection at the base of the hair bulb. It contains blood vessels and nerves that supply oxygen and nutrients necessary for hair growth.

6. Sebaceous (Oil) Gland
The sebaceous gland is attached to the hair follicle and secretes sebum (oil). Sebum lubricates and protects the hair and scalp from dryness.
7. Arrector Pili Muscle
The arrector pili is a tiny smooth muscle attached to the hair follicle. When it contracts due to cold or fear, the hair stands upright, producing "goosebumps."

V. LAYERS OF HAIR SHAFT

Cuticle
The outermost protective layer made of overlapping cells. It protects the inner layers from damage.
Cortex
The middle and thickest layer. It contains melanin, which gives hair its color, and provides strength and elasticity.
Medulla
The innermost core of the hair shaft. It is present mainly in thick hair and contributes to the hair's structure.

VI. PROBLEMS RELATED TO HUMAN HAIR

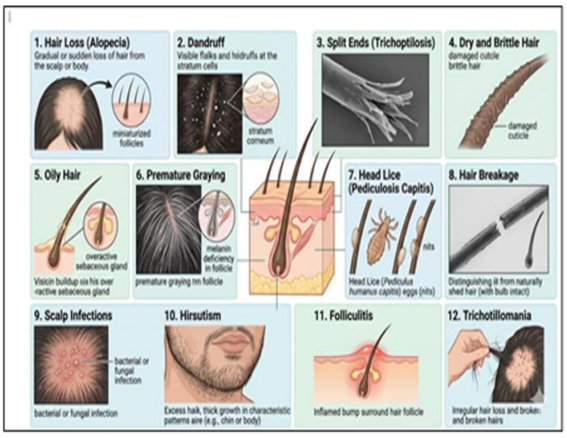

Fig.2 Hair & Scalp Disorders

1. Hair Loss (Alopecia)
Hair loss can occur due to genetics, hormonal changes, stress, nutritional deficiencies, medications,

or certain diseases. It may cause thinning of hair or bald patches on the scalp.

2. Dandruff
Dandruff is a common scalp condition characterized by white flakes of dead skin. It may be associated with dry skin, excess oil production, or fungal growth and is often accompanied by itching.

3. Split Ends (Trichoptilosis)
Split ends occur when the protective cuticle is damaged, causing the hair shaft to split. Frequent heat styling, chemical treatments, and excessive brushing can contribute to this problem.

4. Dry and Brittle Hair
Hair may become dry and fragile due to insufficient moisture, excessive shampooing, sun exposure, chemical treatments, or poor nutrition. Such hair breaks easily and lacks shine.

5. Oily Hair
Overactivity of sebaceous glands produces excess sebum, making hair greasy and difficult to manage. Oily hair can also attract dirt and contribute to dandruff.

6. Premature Graying
Hair turns gray when melanin production decreases. Premature graying may result from genetics, stress, nutritional deficiencies, or certain medical conditions.

7. Head Lice (Pediculosis Capitis)
Head lice are tiny parasitic insects that live on the scalp and feed on blood. They cause intense itching and can spread through close contact or shared personal items.

8. Hair Breakage
Hair breakage occurs when strands become weak and snap easily. Causes include excessive heat styling, chemical processing, rough handling, and nutritional deficiencies.

9. Scalp Infections
Fungal or bacterial infections of the scalp can cause itching, redness, scaling, inflammation, and hair loss. A common fungal infection is ringworm of the scalp.

10. Hirsutism
Hirsutism is excessive hair growth in women in areas where hair is usually minimal, such as the face, chest, and back. It is often associated with hormonal imbalances.

11. Folliculitis
Folliculitis is inflammation or infection of hair follicles, resulting in small red bumps, pus-filled lesions, itching, and discomfort.

12. Trichotillomania
Trichotillomania is a psychological condition in which a person has a strong urge to pull out their own hair, leading to noticeable hair loss.

VII. PLANT PROFILE

Rosmarinus officinalis
Rosemary is an aromatic evergreen medicinal herb belonging to the family Lamiaceae. It is native to the Mediterranean region and is widely cultivated throughout the world for culinary, cosmetic, and medicinal purposes. Rosemary leaves contain several bioactive compounds including rosmarinic acid, carnosic acid, carnosol, flavonoids, and essential oils such as cineole and camphor. These phytochemicals possess strong antioxidant, antimicrobial, anti-inflammatory, and circulation-enhancing properties. In hair-care formulations, rosemary is valued for its ability to stimulate blood circulation in the scalp, improve nutrient supply to hair follicles, reduce hair fall, and promote healthy hair growth. Its antioxidant activity helps protect hair follicles from oxidative stress and environmental damage. Due to its pleasant aroma and therapeutic properties, rosemary is commonly incorporated into shampoos, hair oils, conditioners, and scalp treatments.

Plant Profile of Licorice (Glycyrrhiza glabra)
Licorice is a perennial medicinal plant belonging to the family Fabaceae. The dried roots and rhizomes of licorice have been used in traditional medicine systems for centuries because of their therapeutic properties. Licorice root contains important phytoconstituents such as glycyrrhizin, liquiritin, isoliquiritigenin, flavonoids, saponins, and polysaccharides. These compounds exhibit anti-inflammatory, antimicrobial, antioxidant, and

soothing activities. In hair and scalp care products, licorice helps reduce scalp irritation, itching, redness, and dandruff while providing natural conditioning effects. The presence of natural saponins contributes to mild cleansing activity, making it suitable for herbal shampoo formulations. Licorice also helps maintain scalp moisture balance and protects the scalp from microbial infections, resulting in healthier and stronger hair.

VIII. COMBINED SIGNIFICANCE IN HERBAL POWDER SHAMPOO

The combination of rosemary leaf powder and licorice root powder provides a synergistic effect in herbal powder shampoo formulations. Rosemary enhances scalp circulation and supports hair follicle health, while licorice offers anti-inflammatory, anti-dandruff, and soothing benefits. Together, they contribute to effective cleansing, scalp protection, improved hair strength, reduced hair fall, enhanced shine, and overall hair health. Their natural antioxidant and antimicrobial properties make them excellent active ingredients for developing a safe, eco-friendly, and effective herbal powder shampoo.

Ingredient	Quantity (g)	Function
Rosemary leaf powder	20	Hair growth promoter
Licorice root powder	15	Anti-inflammatory
Shikakai powder	18	Natural cleanser
Reetha powder	15	Natural surfactant
Amla powder	10	Hair strengthening
Hibiscus powder	8	Conditioner
Fenugreek powder	5	Moisturizer
Neem powder	5	Anti-dandruff
Aloe vera powder	2	Hydrating agent
Orange peel powder	2	Natural fragrance
Total = 100 g		

Table 1 Ingredient

IX. MECHANISM OF ACTION

Cleansing
Reetha contains natural saponins.
Shikakai removes dirt and excess oil.
Produces mild foam without synthetic surfactants.
Hair Growth Support
Rosemary increases scalp microcirculation.
Improves nutrient delivery to hair follicles.
Dandruff Reduction
Neem exhibits antifungal activity.
Licorice reduces inflammation and itching.
Hair Conditioning
Hibiscus and aloe vera improve smoothness.
Fenugreek reduces dryness and frizz.

X. DETAILED METHOD OF PREPARATION OF ROSEMARY–LICORICE HERBAL POWDER SHAMPOO

Materials Required	Equipment Required
Rosemary leaf powder – 20 g	Analytical balance
Licorice root powder – 15 g	Stainless steel trays
Shikakai powder – 18 g	Hot air oven
Reetha powder – 15 g	Mixer grinder
Amla powder – 10 g	Mechanical pulverizer
Hibiscus flower powder – 8 g	Sieve No. 80 (180 μm)
Fenugreek seed powder – 5 g	Mortar and pestle
Neem leaf powder – 5 g	Polyethylene bags
Aloe vera powder – 2 g	Airtight HDPE containers
Orange peel powder – 2 g	Desiccator

Table 2 Materials Required

Step 1: Collection and Authentication of Plant Materials
Fresh rosemary leaves, licorice roots, shikakai pods, reetha fruits, amla fruits, hibiscus flowers, fenugreek seeds, neem leaves, and orange peels should be

collected from a reliable herbal supplier or medicinal plant garden.
All plant materials should be authenticated by a botanist or pharmacognosy department before use. Foreign matter such as dust, soil particles, damaged plant parts, insects, and other contaminants should be removed manually.

Step 2: Washing and Cleaning
The collected plant materials should be thoroughly washed with distilled water to remove dirt, microorganisms, and adhering impurities.
After washing, excess water should be drained using blotting paper or a clean cotton cloth.
The cleaned materials should be spread uniformly on stainless steel trays

Step 3: Drying of Plant Materials
The washed materials should be dried under shade for 5–7 days to prevent degradation of thermolabile phytochemicals.
After shade drying, final drying should be carried out in a hot air oven at 40–45°C for 4–6 hours.
Drying should continue until constant weight is achieved.
Purpose
Prevent microbial growth
Improve shelf life
Facilitate grinding
Preserve active constituents
Expected Moisture Content
Less than 10%.

Step 4: Pulverization
The dried materials should be separately ground using a mechanical grinder.
Each ingredient should be pulverized individually to obtain a fine powder.
Special care should be taken to avoid excessive heat generation during grinding because heat may degrade volatile compounds present in rosemary and orange peel.

Step 5: Sieving
The powdered materials should be passed through Sieve No. 80.
This step ensures:
Uniform particle size
Improved blending
Better flow properties
Enhanced cleansing performance
Any coarse particles retained on the sieve should be re-pulverized and sieved again.

Step 6: Weighing of Ingredients
Accurately weigh all powdered ingredients according to the formulation.

Ingredient	Quantity (g)
Rosemary powder	20
Licorice powder	15
Shikakai powder	18
Reetha powder	15
Amla powder	10
Hibiscus powder	8
Fenugreek powder	5
Neem powder	5
Aloe vera powder	2
Orange peel powder	2
Total	100 g

Table 3 Ingredient

Step 7: Geometric Mixing
To achieve uniform distribution, geometric dilution should be employed.
Procedure
1. Place the smallest quantity ingredient (orange peel powder) in a mortar.
2. Add an equal quantity of aloe vera powder and mix thoroughly.
3. Add fenugreek powder gradually and mix.
4. Incorporate neem powder and hibiscus powder.
5. Add amla powder slowly while mixing continuously.
6. Add licorice powder.
7. Add rosemary powder.
8. Finally add shikakai and reetha powders.
Mix continuously for 15–20 minutes until a homogeneous blend is obtained.

Step 8: Quality Inspection
The prepared powder shampoo should be visually inspected for:
Uniform color
Pleasant odor
Absence of lumps
Smooth texture
Uniform particle size

Any lumps present should be broken and the powder should be re-sieved.

Step 9: Dehumidification
The blended powder should be placed in a desiccator containing silica gel for 24 hours.
Purpose
Remove residual moisture
Improve flowability
Prevent microbial contamination
Increase shelf life

Step 10: Packaging
The finished shampoo powder should be packed in:
HDPE containers
Amber glass containers
Laminated aluminum pouches
The containers should be tightly closed immediately after filling.

Step 11: Labeling
Each container should contain:
Product name
Batch number
Date of manufacture
Expiry date
Storage conditions
Directions for use

Directions for Use
1. Take 10–15 g of shampoo powder in a bowl.
2. Add 20–30 mL of lukewarm water.
3. Mix to form a smooth paste.
4. Apply to wet hair and scalp.
5. Massage gently for 2–3 minutes.
6. Leave for 2 minutes.
7. Rinse thoroughly with water.

XI. ADVANCED EVALUATION PARAMETERS OF ROSEMARY LEAF POWDER AND LICORICE ROOT POWDER HERBAL SHAMPOO

1. Organoleptic Evaluation
Organoleptic evaluation is the preliminary assessment of the prepared shampoo powder using sensory observations. The formulation is examined for its color, odor, appearance, texture, and homogeneity. A good herbal shampoo powder should possess a uniform greenish-brown color, characteristic herbal aroma, smooth texture, and should be free from lumps and foreign particles. This evaluation helps determine the overall acceptability and quality of the product.

Results
Color: Greenish-brown
Odor: Pleasant herbal aroma
Texture: Fine and smooth
Appearance: Uniform powder
Homogeneity: No visible segregation

2. Powder Flow Properties
A. Angle of Repose
The angle of repose is used to determine the flowability of the powder. It is measured by allowing the powder to flow through a funnel and form a cone-shaped pile. The angle formed between the pile surface and horizontal plane is measured.

Significance
Indicates flow characteristics.
Essential for packaging and processing.
Lower angle indicates better flow.
Result
20°–30° indicating excellent flow properties.

B. Bulk Density
Bulk density is defined as the mass of powder divided by its untapped volume.

Significance
Indicates packing ability.
Helps in container size selection.
Determines storage requirements.

Result
0.40–0.55 g/cm³

C. Tapped Density
Tapped density is determined after mechanically tapping the measuring cylinder containing powder until constant volume is obtained.

Significance
Measures compactibility.
Used for calculating Carr's Index and Hausner Ratio.
Result

0.50–0.65 g/cm³

D. Carr's Compressibility Index

Carr's Index evaluates powder compressibility and flow behavior.

Interpretation

Carr's Index (%)	Flow Property
5–15	Excellent
16–20	Good
21–25	Fair
>25	Poor

Table 4 Carr's Index (%)

Result

10–15%

E. Hausner Ratio

Hausner Ratio is another indicator of powder flowability.

Interpretation

Hausner Ratio	Flow Property
1.00–1.25	Excellent
>1.25	Poor

Table 5 Hausner Ratio (%)

Result

1.10–1.18

3. Physicochemical Evaluation

A. pH Determination

The pH of a 10% shampoo dispersion is measured using a calibrated digital pH meter.

Significance

Maintains scalp compatibility.

Prevents irritation.

Preserves hair cuticle integrity.

Result

5.5–6.2

This range is ideal for healthy scalp and hair.

B. Moisture Content

Moisture content is determined by drying the sample at 105°C until constant weight is obtained.

Significance

Influences stability.

Prevents microbial growth.

Enhances shelf life.

Result

2–5%

C. Total Ash Value

The sample is incinerated in a silica crucible at 600°C to remove organic matter, leaving inorganic residue.

Significance

Indicates purity.

Detects contamination and adulteration.

Result

4–10%

4. Foam Evaluation

A. Foam Volume

A known quantity of shampoo powder is dispersed in water and shaken mechanically. The foam generated is measured immediately.

Significance

Indicates cleansing efficiency.

Improves consumer acceptance.

Result

70–110 mL

B. Foam Stability

The foam volume is measured at different time intervals after shaking.

Significance

Indicates persistence of foam.

Reflects surfactant performance.

Result

80–90% foam retained after 10 minutes.

5. Wetting Time

A filter paper disc is floated on the shampoo solution and the time required for complete wetting is recorded.

Significance

Measures reconstitution efficiency.

Indicates ease of application.

Result

15–40 seconds

6. Dirt Dispersion Test

A small quantity of India ink is added to the shampoo solution and shaken. The distribution of ink in foam and water layers is observed.

Significance

Evaluates cleansing performance.

Indicates ability to remove dirt from hair.

Result
Most ink particles should remain in water rather than foam.

7. Surface Tension Measurement
Surface tension is measured using a stalagmometer or tensiometer.
Significance
Lower surface tension improves cleansing action.
Enhances spreading over hair shafts.
Result
30–35 dynes/cm

8. Reconstitution Study
The time required to convert shampoo powder into a smooth, lump-free paste after mixing with water is determined.
Significance
Indicates user convenience.
Evaluates dispersibility.

Result
Less than 30 seconds.

9. Conditioning Performance Test
Human volunteers evaluate the shampoo after washing based on softness, smoothness, shine, and ease of combing.
Parameters Assessed
Hair softness
Shine
Silkiness
Frizz reduction
Ease of combing
Result

Parameter	Score (Out of 10)
Softness	8.5
Smoothness	8.4
Shine	8.2
Manageability	8.6

Table 6 Parameter (%)

10. Anti-Dandruff Activity
The antifungal activity of the shampoo is evaluated against Malassezia furfur using the agar well diffusion method.
Significance
Determines dandruff-control efficacy.
Measures antifungal potential.
Result
Sample Zone of Inhibition

Rosemary Extract	10–14 mm
Licorice Extract	12–16 mm
Combined Shampoo	18–25 mm

Table 7 Rosemary Extract

REFERENCES

[1] Trease and Evans Pharmacognosy. Evans WC. Trease and Evans Pharmacognosy. 17th ed. London: Elsevier; 2020.
[2] Indian Materia Medica. Nadkarni AK. Indian Materia Medica. Vol. 1. Mumbai: Popular Prakashan; 2019.
[3] The Wealth of India. Council of Scientific and Industrial Research. The Wealth of India: Raw Materials. New Delhi: CSIR; 2018.
[4] Textbook of Pharmacognosy. Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. Pune: Nirali Prakashan; 2021.
[5] Chabra A, Kaur A, Gupta S. Formulation and evaluation of licorice shampoo in comparison with commercial shampoo. J Pharm Bioallied Sci. 2018;10(4):245-251.
[6] Raslamol K, Joseph J, Thomas P. Formulation and evaluation of polyherbal powder shampoo. Int J Pharm Biol Arch. 2023;14(2):75-84.
[7] Kumar MP, Bhowmik D, Chiranjib B. Development and evaluation of herbal shampoo powder. World J Pharm Pharm Sci. 2016;5(8):1234-1245.
[8] Chouhan A, Sharma P. Formulation and evaluation of herbal powder shampoo. J Drug Deliv Ther. 2017;7(6):102-108.
[9] Mandave PS, Patil RS, Shinde V. Formulation and evaluation of polyherbal powdered shampoo for healthy hair. Int J Res Pharm Sci. 2025;16(1):85-95.
[10] Draelos ZD. Essentials of hair care products. Dermatol Clin. 2019;37(4):413-418.
[11] Barel AO, Paye M, Maibach HI. Handbook of Cosmetic Science and Technology. 5th ed. Boca Raton: CRC Press; 2022.
[12] Harry RG. Harry's Cosmeticology. 9th ed. New York: Chemical Publishing Co.; 2020.

[13] Sharma PP. Cosmetics: Formulation, Manufacturing and Quality Control. 6th ed. New Delhi: Vandana Publications; 2021.
[14] Ali B, Al-Wabel NA, Shams S, et al. Essential oils used in aromatherapy: A review. Asian Pac J Trop Biomed. 2015;5(8):601-611.
[15] Panahi Y, Taghizadeh M, Marzony ET, Sahebkar A. Rosemary oil versus minoxidil for androgenetic alopecia. Skinmed. 2015;13(1):15-21.
[16] Hosseinzadeh H, Nassiri-Asl M. Pharmacological effects of rosemary. Iran J Basic Med Sci. 2014;17(9):691-698.
[17] Pastorino G, Cornara L, Soares S, Rodrigues F, Oliveira MBPP. Liquorice (Glycyrrhiza glabra): A phytochemical and pharmacological review. Phytother Res. 2018;32(12):2323-2339.
[18] Fiore C, Eisenhut M, Ragazzi E, et al. Antiviral effects of glycyrrhiza species. Phytother Res. 2008;22(2):141-148.
[19] Mukherjee PK. Quality Control and Evaluation of Herbal Drugs. New Delhi: Elsevier; 2019.
[20] Harborne JB. Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis. London: Chapman & Hall; 2018.
[21] Wagner H, Bladt S. Plant Drug Analysis: A Thin Layer Chromatography Atlas. 3rd ed. Berlin: Springer; 2016.
[22] Sethi PD. HPTLC Quantitative Analysis of Pharmaceutical Formulations. New Delhi: CBS Publishers; 2017.
[23] Snyder LR, Kirkland JJ, Dolan JW. Introduction to Modern Liquid Chromatography. 3rd ed. Hoboken: Wiley; 2019.
[24] Stuart B. Infrared Spectroscopy: Fundamentals and Applications. Chichester: Wiley; 2018.
[25] Goldstein JI, Newbury DE. Scanning Electron Microscopy and X-Ray Microanalysis. 4th ed. New York: Springer; 2018.
[26] International Council for Harmonisation (ICH). Q1A(R2): Stability Testing of New Drug Substances and Products. Geneva: ICH; 2003.
[27] World Health Organization. Quality Control Methods for Herbal Materials. Geneva: WHO; 2019.
[28] World Health Organization. WHO Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. Geneva: WHO; 2018.
[29] United States Pharmacopeia. USP–NF General Chapters on Herbal Medicines. Rockville: USP Convention; 2024.
[30] British Pharmacopoeia Commission. British Pharmacopoeia 2025. London: The Stationery Office; 2025.