ORIGINAL ARTICLE

# Herbal Shampoo Tablet: Benefits, Preparation and Evaluation

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## Abstract

**Aim:** In the contemporary era, there is a growing preference for natural and herbal alternatives due to their renewability, minimal adverse effects, and cost-effectiveness. This novel work aims to prepare and evaluate an environmentally conscious herbal shampoo in tablet form. This pioneering endeavor by the formulator seeks to create an essential cosmetic product for hair hygiene and attractiveness using natural ingredients. **Material and Methods:** Two formulations, F1 and F2, were developed with varying concentrations of ingredients to incorporate desired properties such as cosmetic enhancement, hair conditioning, stimulation, antimicrobial action, and hair growth promotion. The shampoo tablets were prepared using the direct compression method and subjected to a battery of tests, including particle size analysis, flow property assessment (angle of repose, bulk density, tapped density, Hausner ratio, Carr's index), and physicochemical evaluation (hardness, pH determination, loss on drying, swelling index, wetting time, dirt dispersion, foaming ability, and foam stability). **Results:** The conditioning performance evaluation aimed to ensure that the shampoo tablets maintain environmental sustainability by posing no harm to soil or atmosphere after use. **Conclusion:** Both formulations exhibit promising characteristics for further investigation.

**Key words:** Cosmetic, foaming ability, hair conditioner, hair regrowth, shampoo tablet

## INTRODUCTION

In a world increasingly drawn to the allure of natural remedies, the emergence of herbal shampoo tablets marks a significant stride toward sustainable and holistic hair care. As we delve into the realm of botanical beauty, it becomes evident that these compact yet potent alternatives offer not only a cleansing experience but also a journey into the bounties of nature. Let's unravel the wonders and possibilities encapsulated within each herbal shampoo tablet.

Indeed, throughout history, hair has been valued for its esthetic appeal and functional significance. Like, i.e., offering protection against factors of external, apocrine, sebum sweat and phenomenon production and thermoregulation. Over time, various cultures have developed practices and products to care for and beautify

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hair. The evolution of hair care products reflects this long-standing fascination with hair. From ancient times, people have used herbs and natural ingredients for cleaning and managing their hair. The introduction of soap marked a significant advancement in personal hygiene, followed by the development of branded shampoo products that cater to different hair types and needs. Today, shampooing has become a widespread practice, with an array of options available to consumers. Beyond cleansing, modern hair care products offer nourishment, texture enhancement, and overall hair health. This ongoing innovation in hair care reflects society's enduring interest in maintaining and enhancing the beauty of this integral aspect of human appearance.[1,2]

Absolutely, shampoos are predominantly used as cosmetic products in our daily hair care routines. They are designed to cleanse both the scalp and the hair, removing dirt, oil, and other impurities accumulated throughout the day. Shampoos typically consist of a viscous solution containing a combination of cleansing agents, additives for fragrance and texture, preservatives for shelf-life, and active ingredients for specific purposes such as moisturizing, volumizing, or strengthening. The application of shampoo usually involves wetting the hair, applying the shampoo, and massaging it into the scalp and hair to create a lather and effectively cleanse. Afterward, the shampoo is rinsed out with water. One of the primary goals of using shampoo is to remove dirt and excess oil from the hair while minimizing the removal of natural oils produced by the scalp (sebum). This helps maintain the natural balance of the scalp and hair, preventing excessive dryness or oiliness. Overall, shampooing serves both functional and esthetic purposes, leaving the hair clean, refreshed, and often fragrant, contributing to our daily grooming and personal care routines.[3,4]

Shampoo should act non-toxic and non-irritating to the scalp and hair. It should remove sebum and atmospheric pollutants from the scalp and hair, remove the residues of previously applied hair styling lotions and sprays, and deliver an optimal level of foam for the expectations of the user.[5,6]

Shampoos are of the following types. Powder shampoo, clear liquid shampoo, lotion shampoo, solid gel shampoo, medicated shampoo, and liquid herbal shampoo.[7,8]

Indeed, there has been a growing demand for herbal formulations in the world market, including in the treatment of conditions like dandruff. While traditional treatments for dandruff have included ingredients such as zinc pyrithione, salicylic acid, imidazole derivatives, glycolic acid, steroids, and sulfur and coal tar derivatives, there are limitations associated with some of these agents, particularly in terms of clinical efficacy and potential side effects.[9,10]

In a world increasingly drawn to the allure of natural remedies, the emergence of herbal shampoo tablets marks a significant stride toward sustainable and holistic hair care. As we delve into the realm of botanical beauty, it becomes evident that these compact yet potent alternatives offer not only a cleansing experience but also a journey into the bounties of nature. Let's unravel the wonders and possibilities encapsulated within each herbal shampoo tablet.

Furthermore, the shampoo improves good health and well-being, encourages responsible consumption and production, and promotes climate action. It is important that shampoo contain healthy ingredients. Other shampoos consist of chemicals, which harm either skin or health. However, the shampoo tablet is an excellent alternative to usual shampoo at competitive prices, making it easier to choose the sustainable shampoo tablet, and this aims to reduce the usage of plastics in this world.

## MATERIALS AND METHODS

The herbal shampoo powder was formulated using the following natural ingredients. Amla, neem, shikakai, retha powders were brought from Packed and Marketed by RK Naturals, Vijayawada, Krishna Dist., A.P. Henna, Hibiscus, Banyan powders were brought from Manufactured and Marketed by Nithyam Natural Remedies, Padipata, Tirupati, A.P. Acacia brought from Molychem, Babu Genu Road, Mumbai. The ingredients amla, as hair growth, neem as antimicrobial, shikakai as form base, henna as hair conditioner, retha as a forming agent, hibiscus as hair regrowth, banyan as hair stimulant, onion and acacia were used.

### Formulation of herbal shampoo tablet

All the plant material was dried and grinded. Herbal powders for shampoo preparation were done by weighing individually. These fine materials were mixed thoroughly to form a homogeneous fine powder. Then this fine powder was passed through sieve no: 80, to get the sufficient quantity of fine powder. The manufacturing method for tablets is done by direct compression which is simple and economical because it requires fewer processing steps than other techniques. The term direct compression is used to define the process by which tablets are compressed directly from powder blends of active ingredients and excipients, which flow uniformly in the dies and form a film compact.[11,12] Tablet composition is presented in Table 1 and image [Figure 1] of punched tablets.

### General characteristics of powder

Certainly, when evaluating general powder characteristics, several parameters are commonly assessed to understand the physical properties and behavior of the powder. Three key parameters include bulk density, particle size distribution, and angle of repose.

**Table 1:** Formula for herbal shampoo tablet

| S. No | Ingredients | Tablet (F1) (600 mg) | Tablet (F2) (600 mg) |
|---|---|---|---|
| 1. | Amla | 30 mg | 20 mg |
| 2. | Neem | 40 mg | 20 mg |
| 3. | Shikakai | 150 mg | 150 mg |
| 4. | Henna | 60 mg | 60 mg |
| 5. | Retha | 100 mg | 100 mg |
| 6. | Hibiscus | 100 mg | 100 mg |
| 7. | Banyan | 70 mg | 70 mg |
| 8. | Acacia | 50 mg | 50 mg |

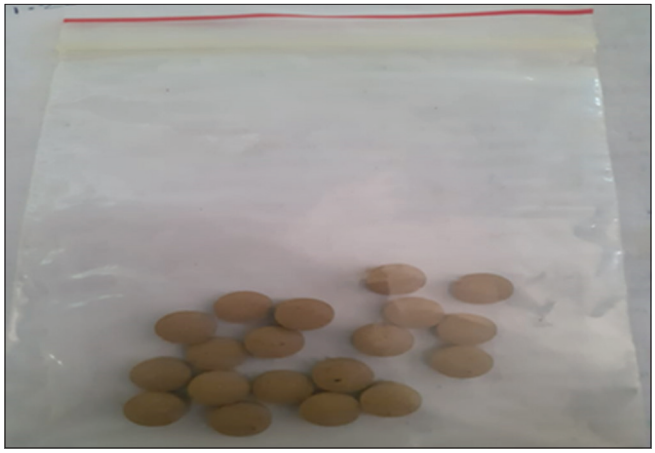

**Figure 1:** Punched herbal shampoo tablets

### *Test of particle size*

The size of a particle influences properties such as grittiness and spreading. It is determined using sieving techniques, where the powder is passed through sieves of varying mesh sizes to separate particles based on their size.[13]

### *Angle of repose by funnel method*

The angle of repose is the maximum angle at which a pile of powder remains stable without further slumping or sliding. It is an indicator of powder flowability, cohesion, and interparticle friction. The angle of repose can be measured experimentally by allowing the powder to flow freely onto a flat surface until it forms a cone. The tangent of the angle formed by the cone and the flat surface represents the angle of repose.[6]

### *Bulk density*

Bulk density refers to the mass of a powder divided by its bulk volume. It is usually expressed in grams per milliliter (g/mL) or kilograms per cubic meter (kg/m$^3$). Bulk density provides information about the packing arrangement of particles within the powder. It can influence flow properties, compressibility, and handling characteristics. Bulk density can be measured using various methods, such as tapped density, poured density, and bulk density using a graduated cylinder.[6]

Bulk density = Mass of the herbal shampoo/Volume of the herbal shampoo

### *Tapped density*

Tapped density is indeed similar to bulk density, but it is measured after the powder has been tapped or subjected to vibrations to settle it more densely. This tapping process helps to reduce the void spaces between particles and provides a more accurate measure of the powder's packing efficiency. The powder is first filled into a graduated cylinder up to a specified volume. The cylinder containing the powder is then tapped or subjected to vibrations, typically a specified number of times (e.g., 100 taps), using a tapping apparatus. After tapping, any excess powder that may have risen above the top of the cylinder is carefully removed to ensure accuracy. The volume of the powder in the cylinder after tapping is measured again.[6]

Tapped density = Weight of powder/Tapped powder volume

### *Hausner ratio*

The Hausner ratio is calculated by dividing the tapped density of a powder by its bulk density. It serves as a measure of the degree of packing or cohesion within the powder. A Hausner ratio close to 1.2 indicates that there is minimal change in volume between the loose and tapped states, suggesting good flowability. Conversely, a Hausner ratio significantly higher than 1.6 indicates that the powder undergoes considerable compaction upon tapping, which can impede flow and handling.[14]

### *Carr's index*

Carr's index is used to predict the compressibility and flowability of granules. It is determined as the percentage difference between tapped density and bulk density, relative to tapped density. A lower Carr's index indicates better flowability and compressibility of the powder or granules.

$C = (\rho t - \rho b)/\rho t \times 100$, where $\rho t$ is tapped density and $\rho b$ is bulk density[15]

### *Physicochemical evaluation*

#### *Physical appearance/visual inspection*

The samples were observed for their physical appearance/visual inspection and evaluated for defects in tablet manufacturing.

#### *Hardness*

For each formulation, the hardness and thickness of 20 tablets were determined. The hardness test was tested by Monsanto hardness tester, and the thickness of tablets was tested by Vernier Calipers.[14]

### *Determination of pH*

1 g of tablet was prepared with 11 ml of distilled water, and pH was determined in a pH meter at 27°C.[14]

### *Loss on drying*

About 2 g of powder is taken in a Petri dish and placed in a desiccator for 2 days over calcium chloride crystals. Then, the powder was taken, and the weight was checked to determine the loss during drying.[14]

### *Swelling index*

About 1 g of shampoo powder is taken into a glass stopper cylinder containing 25 mL of water. Then, the measuring cylinder is shaken for 1 h with an interval of 10 min. The solution is kept aside for 3 h without shaking. Volume is measured in mL.[16]

### *Dirt dispersion*

Take a large test tube containing 10 mL of distilled water. Add two drops of the shampoo being tested into the test tube. Add one drop of ink (often a water-soluble dye) to the test tube. The ink serves as a simulated dirt or soil particle. Stopper the test tube securely to prevent leakage. Shake the test tube vigorously 10 times. This shaking action simulates the agitation experienced during shampooing. After shaking, observe the foam or lather formed in the test tube. Estimate the amount of ink dispersed in the foam:

None: No ink is visible in the foam.

Light: A small amount of ink is dispersed in the foam, indicating partial cleaning.

Moderate: A moderate amount of ink is dispersed in the foam, suggesting effective cleaning.

Heavy: A significant amount of ink is dispersed in the foam, indicating thorough cleaning.

This test provides a qualitative assessment of the shampoo's ability to disperse and remove dirt or soil particles from the hair and scalp.[17]

## *Foaming ability and test on stability of foam*

The foaming ability and stability of foam are important characteristics of shampoo formulations that can influence consumer perception and product performance. Here is how the cylinder shake method is used to assess these properties. The Foaming Ability Test was performed by preparing a 1% solution of the shampoo being tested by diluting it appropriately with water. Pour 50 mL of the 1% shampoo solution into a 250 mL graduated cylinder. Cover the cylinder with a hand or stopper to prevent spillage. Shake the cylinder vigorously 10 times. Immediately after shaking, record the total volume of foam produced in the cylinder. The volume of foam obtained indicates the foaming ability of the shampoo.

After recording the initial foam volume, continue monitoring the foam stability at regular intervals. Record the volume of foam remaining in the cylinder at 1-min intervals for up to 4 min. This allows for the assessment of how well the foam maintains its volume and structure over time. A shampoo with good foam stability will retain a significant portion of its initial foam volume even after several minutes.[18]

### *Wetting time*

Cut canvas into disc shapes with a 1-inch diameter. Ensure that the discs are uniform in size and weight, with the average weight being 0.44 g/disc. Prepare a 1% solution of the shampoo to be tested. Pour the shampoo solution into a suitable container, such as a beaker or Petri dish, ensuring that there is enough solution to completely submerge the canvas disc. Place a canvas disc gently on the surface of the shampoo solution, allowing it to float. Observe the time it takes for the disc to start sinking or becoming fully wetted by the shampoo solution. Once the disc begins to sink or shows signs of being fully wetted, record the time elapsed. Record the wetting time, which is the time it took for the disc to start sinking or become fully wetted. Repeat the test multiple times with different samples of the shampoo solution to ensure consistency and accuracy. The wetting time provides information about how quickly the shampoo solution wets or penetrates the canvas disc. Shorter wetting times indicate faster wetting and better penetration of the shampoo solution into the material. Longer wetting times may suggest slower wetting and less effective penetration.[19]

## *Conditioning performance evaluation*

Obtain artificial hair tresses of Indian women from a reputable salon. Categorize the tresses into two groups, each approximately 10 cm in length and weighing 5 g. Designate one group as the control, which remains unwashed, and the other as the test group to be washed with the formulated shampoo. Prepare a solution of the formulated shampoo tablet by combining it with water in the proportion of 10:15 (shampoo to water) in a conical flask. Immerse the test swatch of the hair tress into the shampoo solution for 2 min. After washing, rinse the tress thoroughly with 50 mL of distilled water to remove any residue. Repeat this washing procedure for a maximum of 10 times to evaluate the shampoo's performance over multiple wash cycles. Allow the washed tress to air dry at room temperature after each washing cycle. Conduct a blind touch test to assess the conditioning effect of the shampoo on the hair tresses. Perform the test by having individuals touch and feel the tresses without knowing which ones were washed with the formulated shampoo.

Rate the softness and smoothness of the tresses based on a score from 1 to 4. 4: Excellent (indicating exceptional softness and smoothness), 3: Good, 2: Satisfactory, 1: Poor. Evaluate the scores assigned to the tresses washed with the formulated shampoo to determine its conditioning performance. Higher average scores indicate better conditioning effects, reflecting improved softness and smoothness of the hair tresses.[11]

### *Packaging*

#### *System*

Shampoo establishes multiple benefits for the environment. The packaging is done in glass jars, so there is no plastic waste, and the composition of the shampoo does not contain chemicals that would pollute water. It is also suitable for the individual because the shampoo does not contain chemicals that could harm the skin, and it is even available for people who need special shampoos. Reducing waste is the main objective of shampoo, positively impacting the climate. At an environmental level and social level, the product ensures healthier hair for individuals.

## RESULTS

A pure herbal tablet was formulated by mixing amla, neem, banyan, henna, reethu, shikakai, and onion powder in definite amounts, as given in Table 1.

### Manufacture of tablets by direct compression method

Unlike conventional shampoos laden with synthetic chemicals, these tablets harness the power of herbs meticulously selected from nature's pharmacy. From revitalizing amla to henna, each ingredient tells a story of tradition, efficacy, and sustainability. These plant materials contain phytochemicals, for example, saponins which are normal surfactants having great detergency and frothing properties. Various regular materials are accessible for use as viscosity enhancers. No rat hole was seen during the progression of powder from the hopper. Capping and sticking were not noticed. The powder obtained for the trial batches (F1-F2) was satisfactory.

### General powder characteristics

The general powder characteristics of F1 and F2 are given in Table 2.

### *Test of particle size*

The particle size distribution of the F1 and F2 powder mix is given in Table 2.

**Table 2:** General powder characteristics of F1 and F2

| S. No. | Property | F1 | F2 |
|---|---|---|---|
| 1 | Particle size (μm) | 590.84 | 605.650 |
| 2 | Angle of repose (°) | 35°.6\ | 34°.75\ |
| 3 | Bulk density (g/cm$^3$) | 0.63 | 0.89 |
| 4 | Tapped density (g/cm$^3$) | 0.69 | 0.95 |
| 5 | Hausner's ratio | 1.095 | 1.067 |
| 6 | Carr's index (%) | 9.58 | 6.32 |
| 7 | Flowability | Good | Good |

### *Angle of repose by funnel method*

The angle of repose of the resulting powder combination affirms the great flowability of the powder [Table 2]. The great flowability could be ascribed to the increased particle size of the powder particles. The particle size in a drug substance can affect how the formulation behaves during processing. In addition, the moisture content of the powder mixture is evaluated to assess its ability to absorb moisture during tablet compression. The powder mixture shows only a slight increase in moisture content (<0.1%) when exposed to humidity conditions similar to those in tablet manufacturing environments. This suggests that the powder mixture is non-hygroscopic, meaning it does not readily absorb moisture from the surrounding environment.

### *Bulk density and tapped density*

The values are given in Table 2.

### *Hausner ratio and Carr's index*

Two common methods for assessing the flow properties of granulates are mentioned here Hausner ratio and Carr's index. Values >1.6 indicate poor flowability, whereas values around 1.25 suggest good flowability. This ratio compares the tapped density to the bulk density of the powder, providing insight into its flow behavior. Carr's index values ≤16% indicate good flowability, whereas values exceeding 23% suggest poor flowability. Carr's index is calculated from the bulk density and tapped density and provides an indication of the powder's flow properties. All the values obtained were within acceptable ranges in Table 2.

### *Physicochemical evaluation*

The tablets were assessed using various criteria, including visual inspection, hardness, pH, washability, loss on drying, swelling index, dirt dispersion, foaming ability, wetting time, and conditioning performance. These criteria provide a comprehensive assessment of the tablets' quality and performance across different attributes.

### *Physical appearance/visual inspection*

Visual inspection involves examining the tablets for any defects, such as cracks, chips, or discoloration, which could affect their appearance and quality. The results of visual inspection for the series of formulations are likely presented in Table 3.

### *Hardness*

The hardness of the tablets increased as the concentration of the binder increased. This indicates that the binder plays a role in enhancing tablet hardness. Importantly, the hardness values for all concentrations of the binder were within the specified limits, ensuring that the tablets were robust enough to withstand handling and use without breaking apart. The results of hardness for the series of formulations are likely presented in Table 3.

**Table 3:** Physicochemical evaluation of prepared tablets

| S. No. | Property | F1 | F2 |
|---|---|---|---|
| 1 | Physical appearance/visual inspection | Dark drown, shikakai, and amla such as pleasant odor, with no defects | Dark drown, shikakai, and amla such as pleasant odor, with no defects |
| 2 | Hardness (kg/cm$^2$) | 2.9 | 3.1 |
| 3 | Test on tablet pH | 5.52 | 5.72 |
| 4 | Test on loss on drying (%) | <1 | <1 |
| 5 | Swelling index | 7 | 7 |
| 6 | Dirt dispersion | Satisfactory cleaning ability | Satisfactory cleaning ability |
| 7 | Test on Foam ability and stability of foam | 81 mL | 85 mL |
| 8 | Wetting time (s) | 120 s | 122 s |
| 9 | Conditioning performance evaluation | 2.0 out of 4 | 3.0 out of 4 |

### *Determination of pH*

The pH of shampoos is crucial for improving hair quality, reducing irritation to the eyes, and maintaining scalp health [Table 3]. Mild acidity, similar to the skin's pH, helps prevent hair swelling and promotes the tightening of hair scales, resulting in shinier and healthier-looking hair. The shampoos analyzed in the study were found to be acid-balanced, meaning their pH levels were close to that of the skin. This pH balance is essential for minimizing damage to the hair and scalp while enhancing cleansing effectiveness.

### *Loss on drying*

The loss on drying of the prepared tablets from two formulations was <1% [Table 3]. This indicates that the tablets retain their moisture content well, which is crucial for maintaining their integrity and effectiveness.

### *Swelling index*

The volume occupied by the swollen drug powder was measured at 7 mL [Table 3]. Understanding the swelling behavior of the powder is important for formulation consistency and performance.

### *Dirt dispersion*

The ability of shampoos to disperse dirt is a critical criterion for evaluating their cleansing action. Shampoos that cause ink or dirt to concentrate in the foam are considered of poor quality because it can be difficult to rinse away and may redeposit on the hair. The shampoos evaluated in the study successfully concentrated dirt in the water portion, indicating satisfactory cleaning ability and effectiveness.

### *Foaming ability and test on stability of foam*

The ability of a shampoo to produce foam is an important parameter in its evaluation. This indicates that the formulated shampoo exhibited a good foam volume, suggesting that the foam has good stability [given in Table 3]. Foam stability is crucial as it ensures effective cleansing and coverage of the hair and scalp. The canvas disc method is mentioned as a quick, efficient, and reliable test for evaluating the wetting ability of a shampoo.

### *Wetting time*

Wetting ability refers to how well a shampoo spreads and penetrates through the hair to facilitate cleansing. The wetting time of the prepared tablets is given in Table 3. The paragraph suggests that the formulated shampoo exhibited maximum wetting time, indicating that it contains a minimum concentration of detergents. This finding could imply that the shampoo is gentle and suitable for various hair types, as it does not strip the hair excessively.

### *Conditioning performance evaluation*

The conditioning performance of two shampoos is evaluated based on the mean scores of artificial hair tresses of Indian women. This indicates that the conditioning performance score of the tresses washed with formulated shampoo F2 was comparable to that of F1, suggesting that the formulated shampoo exhibits good conditioning performance. This finding highlights the effectiveness of the shampoo in providing nourishment and manageability to the hair, contributing to overall hair health. The rate of conditioning is given in Table 3. It suggests that the formulated shampoo exhibits favorable characteristics across these parameters, indicating its suitability for cleansing and conditioning the hair effectively.

### *Packaging system*

The shampoo is packaged in glass jars, eliminating plastic waste. Glass is a more sustainable and recyclable material compared to plastic, contributing to efforts to reduce environmental pollution and waste. The composition of the shampoo does not contain chemicals that would pollute water or harm the environment. This reflects a commitment to using natural and eco-friendly ingredients that are gentle

on both hair and the environment. The shampoo is suitable for individuals, including those with sensitive skin or specific hair care needs. By excluding harmful chemicals from its formulation, the shampoo minimizes the risk of skin irritation or adverse reactions, ensuring a safer and more personalized hair care experience for users.

By reducing waste and avoiding harmful chemicals, the shampoo positively impacts both the climate and society. It contributes to environmental sustainability by minimizing pollution and waste generation while also promoting healthier hair for individuals, thereby fostering social well-being. It aligns with the growing consumer demand for products that prioritize health, sustainability, and social responsibility.

## CONCLUSION

The findings of the present investigation affirm the efficacy of herbal shampoo tablets prepared through direct compression. These tablets demonstrate satisfactory cleaning ability and effectiveness, offering a viable alternative to traditional liquid shampoos. By opting for shampoo tablets, individuals contribute to cleaner water and improved sanitation, positively impacting life below water ecosystems. Moreover, the absence of plastic packaging reduces plastic waste, mitigating the threat of pollution in rivers and oceans and further enhancing life below water. In addition to their environmental benefits, these shampoo tablets boast eco-friendly packaging and a convenient, travel-friendly design. With each use, they deliver a concentrated dose of botanical goodness, reflecting a return to simplicity and a tribute to traditional wisdom. While the present investigation sheds light on the promising performance of these shampoo tablets, further research is required, particularly regarding their efficacy in human trials. Continued exploration and refinement of such eco-friendly hair care alternatives hold significant promise for sustainable living and environmental conservation efforts.

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