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PHYSICOCHEMICAL AND PHYTOCHEMICAL CHARACTERIZATION OF LEAF OF *IMPATIENS BALSAMINA*

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Abstract
The physicochemical and phytochemical characterization of *Impatiens balsamina* leaf was conducted to evaluate its potential for medicinal and therapeutic applications. Physicochemical analysis revealed significant total ash (6.45 g/100 g), with acid-insoluble ash (4.27 g/100 g) indicating the siliceous materials presence, while water-soluble ash (5.36 g/100 g) reflecting a high mineral content. Moisture content was low (5.72 g/100 g), contributing to long-term storage viability. The extractive values, particularly alcohol-soluble (18.95 g/100 g) and water-soluble (26.87 g/100 g), suggest the leaf contains a substantial variety of bioactive compounds. Phytochemical screening showed a rich presence of flavonoids, alkaloids, terpenoids, phenols, and saponins, with polar solvents like methanol and ethanol demonstrating the highest extractability. The organoleptic analysis described the leaf powder as light green with a smooth texture and a slightly bitter taste, aligning with the presence of secondary metabolites. These findings highlight the potential of *I. balsamina* leaf in phytochemical extraction and medicinal formulations due to its diverse bioactive components and favorable physicochemical properties.

Keywords: *Impatiens balsamina*, physicochemical analysis, phytochemical screening, medicinal plants, bioactive compounds

1. Introduction

An annual herbaceous plant of the Balsaminaceae family, *Impatiens balsamina* is a popular name for garden balsam. Native to Southeast Asia, the species is extensively cultivated in India for its vibrant flowers and medicinal properties.[1,2] The plant's leaves are among the portions that have historically been used in folk medicine to cure infections, burns, and inflammation. The rich history of *I. balsamina* in ethnomedicine has sparked interest in understanding its biochemical properties and therapeutic potential through modern scientific approaches.[3,4] In recent years, the focus has shifted towards exploring the physicochemical, phytochemical, and metallic content of medicinal plants to better understand their biological significance.[5,6] Physicochemical properties, such as moisture content, ash value, provide insight into the overall stability and quality of plant materials, while phytochemical analysis identifies bioactive compounds like alkaloids, tannins, flavonoids, and phenolics, which contribute to the plant's medicinal properties.[7,8] Moreover, the presence of essential and trace metals in plants is critical for their role in various biological functions, including enzymatic activity and metabolic processes. The metallic content of plants, particularly heavy metals, can also have significant implications for both human health and environmental safety. Studies investigating the phytochemical composition of *I. balsamina* have revealed the presence of

bioactive compounds with potential pharmacological applications.[9,10] Flavonoids, saponins, and phenolic compounds, known for their anti-inflammatory, antioxidant, and antibacterial properties, are among the major constituents isolated from this species. However, comprehensive studies focusing on the physicochemical properties and metallic content of the leaf, particularly within the Indian context, remain scarce.[11,12]

India's diverse climatic and soil conditions can greatly influence the phytochemical and mineral composition of plants, including *I. balsamina*. Investigating the physicochemical characteristics and elemental content of the leaves from plants grown in India is essential for assessing their quality and medicinal value.[13] Furthermore, as concerns over environmental pollution and soil contamination continue to rise, examining the levels of both beneficial and toxic metals in medicinal plants has become a priority to ensure their safe use in therapeutic applications. This research attempts to offer a detailed investigation into the physicochemical, phytochemical of *I. balsamina* leaf collected from Indian habitats.[14,15] By integrating these analyses, the research seeks to offer a comprehensive profile of the plant's potential for medicinal use, along with insights into its safety and efficacy.[16,17] The results of this investigation should reinforce the sustainable application of medicinal plants in both conventional and contemporary medicine, as well as add to the expanding corpus of information on the subject.

2. Material and Methodology

2.1 Plant Collection and Validation

In August 2022, fresh *Impatiens balsamina* leaves were gathered from the Pirhad village area of Shakti district of Chhattisgarh, India. The plant was identified and confirmed by the Botanical Survey of India (BSI), Central National Herbarium (CNH), Allahabad, U.P., India.

Fig. 1 a) *Impatiens balsamina* Plant b) Leaf

2.2 Extraction Techniques

The freshly collected leaves (Fig. 1) were completely cleaned in clean water to get rid of pollutants and grime. They were then dried under shade to prevent degradation of phytochemicals then processed with an electric grinder to a fine powder. Before being used again, the powdered leaf

material was kept in an airtight glass jar. For the extraction process, a Soxhlet apparatus was employed to obtain crude extracts using solvents with increasing polarity. The Soxhlet extraction was carried out for 18-24 hours, or until the siphon tube's solution turned colorless. The crude extracts collected and stored in airtight glass vials for further analysis.

2.3 Physicochemical Analysis

The physicochemical analysis of *Impatiens balsamina* leaves was conducted using our previously reported procedure and standard protocols.[18] Water-soluble ash, water-insoluble ash, total ash, and acid-soluble ash, respectively. These parameters provide insights into the inorganic composition and quality of the plant material.

Total Ash;

To determine total ash, 2 g of finely powdered *I. balsamina* leaves were placed in a pre-weighed crucible. The sample was burnt in a muffle furnace at 500°C until all carbonaceous residue was gone. Following cooling, the amount of ash was weighed, and Equation (1) was used to get the overall ash percentage:

$$\text{Total ash}\% = \frac{Wa}{Ws} \times 100 \quad \text{..... (1)}$$

Where Wa represents the ash weight and Ws the sample weight.

Acid-Soluble and Insoluble Ash

For the examination of ash that is both soluble and insoluble in acid, 5 mL diluted hydrochloric acid (HCl) was carefully introduced into a crucible containing the total ash derived from *I. balsamina* leaves. The solution was stirred to dissolve soluble ash particles. Fine, undissolved particles were separated with filter paper, and rinsed the mixture with distilled water. Heating was continued until the liquid passing through the filter became neutral. After transferring the filter paper containing the insoluble particles to a crucible that had been previously weighed, it was heated on a hot plate until a steady weight was reached. Prior to weighing, the crucible was allowed to cool in a desiccator for thirty minutes. The amount of ash that was soluble and insoluble in acid was determined using Equation (2).

$$\%\ \text{Acid soluble ash} = \frac{\text{weight of soluble ash}}{\text{weight of Total ash}} \times 100 \quad \text{..... (2)}$$

The portion of ash that dissolves in an acidic media is referred to as acid soluble ash. Acid insoluble ash, on the other hand, represents the remaining ash that does not dissolve under acidic conditions. Equation (3) was utilized to compute the amount of acid insoluble ash.

$$\%\text{Acid Insoluble Ash} = \text{Total Ash} - \text{Soluble Ash} \quad \text{.....(3)}$$

Water-Soluble and Insoluble Ash;

For ten minutes, the total ash was brought to a boil in 50 mL of distilled water. After filtering off the water-soluble part, the residue was gathered on Whatman filter paper. After being cleaned with hot water, the insoluble part was burned for ten minutes at 500°C. Weighing the residual material after cooling allowed us to measure the amount of water-soluble ash. The percentages of water-soluble and water-insoluble ash were determined using the following formulas:

Water Soluble and Insoluble Ash:

50 mL of distilled water were used to boil the total ash. In a sanitized beaker or on Whatman filter paper, the resulting undissolved matter was collected. Following a warm water rinse, the residue was collected and heated to 500 °C for ten minutes in a furnace. What was determined to be the water soluble ash was the weight difference between the entire immiscible residue and the total ash. The ash that was soluble in water was determined using Equation (4).

$$\%\ \text{Water soluble ash} = \frac{\text{weight of soluble ash}}{\text{Total ash weight}} \times 100 \quad \text{..... (4)}$$

The portion of the total ash that dissolves in water is referred to as water soluble ash. The amount of ash that remains undissolved after boiling with water is known as water-insoluble ash. Equation (5) was utilized to compute the amount of water-insoluble ash.

$$\text{Water insoluble ash} = \text{Total Ash} - \text{Soluble Ash} \quad \text{.....(5)}$$

Sulphated Ash:

A silicate crucible was first heated to a red-hot state for 15 minutes. After letting it cool in a desiccator, its weight was precisely determined. Then, 2 g of finely powdered leaf material of *I. balsamina* was placed in the crucible. The ignition process was initiated slowly to ensure the powder was completely burned. Once the material had been ignited, it was allowed to cool. After adding 1 mL of concentrated sulfuric acid to the residual that remained, it was slowly heated until the white vapors stopped. Afterward, the crucible was ignited at high temperatures until all black carbon particles had completely disappeared. After letting the crucible cool once more, some sulfuric acid was added. To make sure that all of the organic matter was completely burned, the material was warmed and then ignited again. This process of cooling and reheating continued until two consecutive weight measurements showed a difference of no more than 0.5 mg. The following Equation (6) was used to calculate the sulphated ash:

$$\text{Sulfated ash } \% = \frac{W1}{W2} \times 100 \quad \text{.....(6)}$$

Where W1 is the sulphated ash's weight and W2 is the original plant sample's weight.

2.3. 1. Extractive Values

Water Soluble Extractive Value (WSE):

In a closed flask, 2 g of finely ground *I. balsamina* leaf sample was weighed precisely and combined with 50 mL of distilled water. At room temperature, the mixture was allowed to macerate for eighteen hours. The flask was kept undisturbed for the remaining six hours, with the exception of sporadic stirring with a mechanical stirrer throughout that period. Whatman No. 1 filter paper was used to filter the mixture when the maceration period was over. A crucible that had been previously dried and weighed was filled with a volume of 25 mL of the filtrate, and the solvent was removed by drying it in an oven set to 100°C. Until a steady weight was achieved, the procedure was repeated. Information about the existence of hydrophilic chemicals in the sample can be gleaned from the water-soluble extractive value. The water-soluble extractive value was determined using Equation (7) as follows:

$$\% \text{ Extractive Value Soluble in Water } \% = \frac{Wr}{Wd} \times 100 \quad \text{..... (7)}$$

Whre, Wr represents the weight of the residue following drying, and Wd denotes the weight of the crude drug (a powdered leaf sample).

Alcohol Soluble Extractive Value (ASE):

A sample of 2 g of finely powdered *I. balsamina* leaf was subjected to maceration with 50 mL of ethanol in a sealed container. At room temperature, the maceration process lasted for eighteen hours. After gently shaking the container every 6 hours for the first six hours, it was left undisturbed for the next 12 hours. Following the mixture's filtering, 25 mL of the filtrate were transferred to a shallow dish. The dish was dried and weighed beforehand. Until a constant weight was reached, the solvent was evaporated in an oven set at a regulated 100°C. This technique aids in identifying whether the plant material contains any alcohol-soluble chemicals. Equation (8) is used to determine the alcohol-soluble extractive value.

$$\text{Value of Alcohol Soluble Extractive } \% = \frac{Wr}{Wc} \times 100 \quad \text{.....(8)}$$

Where; Wr = weight of the residue (after drying), Wc = weight of the crude drug (powdered leaf sample)

Loss on Drying (LOD):

A precisely weighed sample of 10 g of finely powdered *I. balsamina* leaf was added to an evaporating plate that had already been pre-weighed. After five hours of drying at 100°C, the sample's weight was recorded every hour until a consistent weight was reached. The constant weight was confirmed when two successive weight measurements, taken after a 30-minute drying period and a subsequent 30-minute cooling period in a desiccator, showed a difference of no more than 0.1 g. Equation (9) was used to calculate the percentage loss on drying.

$$\text{Loss on Drying \%} = \frac{Wbd - Wad}{Wad} \times 100 \quad \text{.....(9)}$$

Where Wbd = weight before drying , Wad = weight after drying

Organic Foreign Matter:

Organic foreign matter is defined as impurities such as insects, mold, animal contamination, or other extraneous plant parts. For this analysis, 100 g of shade-dried *I. balsamina* leaf material was spread on a clean white surface, such as a tile, and examined under visible light. Any foreign materials were physically removed. Afterward, the sample was weighed again, and the organic foreign matter was calculated using the following Equation (10):

$$\text{\% Organic Foreign Matter} = \frac{Wa - Wb}{Wa} \times 100 \quad \text{..... (10)}$$

Where: Wa = initial weight of the plant material, Wb = weight after removal of foreign matter

Dry Matter:

Dry matter refers to the fully dried portion of the plant material. A sample of 100 g of *I. balsamina* leaf was placed in a pre-weighed tray and left in a shaded area until it dried completely. After that, the dried sample's weight was noted. Equation (11) was used to get the proportion of dry matter.

$$\text{\% Dry Matter} = \frac{Wa - Wb}{Wa} \times 100 \quad \text{..... (11)}$$

Where Wa denotes the sample's weight prior to drying and Wb the sample's weight following drying

Bulk Density:

I. balsamina leaf powder was finely ground and put within a cube of 1 cm × 1 cm × 1 cm to find the bulk density. The excess powder was leveled off to maintain uniformity, and the remaining powder was removed and weighed. The bulk density was calculated using the following Equation (12):

$$\text{\% Bulk Density (mg/cm}^3\text{)} = \frac{Ws}{Vs} \times 100 \quad \text{.....(12)}$$

Where; Ws = weight of the powdered sample, Vs = volume of the powdered sample in cm^3.

Organoleptic Analysis:

The organoleptic properties of *I. balsamina* leaf were evaluated by observing the appearance, color, odor, taste, and texture of the powdered sample. The shape and size of the leaf powder, its smell, and other sensory characteristics were recorded based on the guidelines established by Ramdurga et al. (2019).[19] The organoleptic analysis provided an initial assessment of the quality and sensory attributes of the leaf powder.

2.4 Phytochemical Screening

Phytochemical screening of *I. balsamina* leaf was conducted using protocols previously described in standard phytochemical guidelines.[21-22] Various reagents were employed to detect specific phytochemical classes. Shinoda reagent (Mg powder) was used for flavonoids, Wagner reagent for alkaloids, and a combination of trichloromethane (TCM), acetic anhydride, and concentrated sulphuric acid for both terpenoids and sterols. Ferric chloride was used for phenols, while acetic anhydride and sulphuric acid were employed for steroids. Foam test determined saponins, alcoholic ferric chloride identified tannins, and Molisch reagent confirmed carbohydrates. For glycosides,

Salkowski reagent (glacial acetic acid and ferric chloride) was applied, while hydrochloric acid gave red precipitate for phlobatannins and quinones. Lastly, acetic acid was used to determine oxalates. The specific procedures for the screening are outlined below.

Flavonoids:
Using 5 mL of water as the solvent, 2 mL of *Impatiens balsamina* leaf extract was processed. Subsequently, 1 mg of magnesium powder (Shinoda reagent) and 2 mL of the filtrate were combined with hydrochloric acid. Flavonoids were detected by the emergence of a light pink tint.

Alkaloids:
5 mL of the methanol filtrate were mixed with 2 mL of diluted hydrochloric acid. Wagner's reagent was added in little amounts after the mixture was heated in a water bath. The presence of alkaloids was revealed by the appearance of a crimson precipitate.

Terpenoids:
5 mL of TCM, 3 mL of acetic anhydride, and concentrated H_2SO_4 were combined with 2 mL of the extract. The presence of terpenoids was verified by the presence of a dark red coloration at the layer contact.

Steroids:
2 mL of the extract were boiled, chilled, and several drops of acetic anhydride added. When concentrated H_2SO_4 was added, a brown ring formed at the contact, indicating the presence of steroids.

Phenols:
2 mL of the extract were mixed with 1 mL of 5% ferric chloride. Phenols were confirmed by a dark green color.

Sterols:
2 mL of the extract were combined with 2 mL of TCM, 2 mL of acetic anhydride, and one drop of conc. H_2SO_4. Sterols were shown by a violet hue.

Saponins:
After thoroughly shaking 1 g of powdered leaf material with 10 mL of water. Saponins were present as evidenced by the persistent foam production.

Tannins:
A 5% ferric chloride solution was combined with two mL of the extract. The presence of tannins was verified by the development of a pale brown precipitate.

Amino acid:
A water bath was used to reheat 2 mL of *I. balsamina* leaf extract after it had been treated with several drops of a 2% alcoholic Ninhydrin solution. The presence of amino acids (proteins) is indicated by the formation of a deep blue or violet precipitate.

Carbohydrates:
After treating 2 mL of the extract with the Molisch reagent (alcohol-based α-naphthol), concentrated H_2SO_4 was carefully poured down the sides of the beaker. A red-purple color at the interface indicated carbohydrates.

Glycosides:
First, 1 mL of glacial acetic acid and fresh ferric chloride were added to 2 mL of the extract. Next, 1

mL of sulphuric acid was added. The presence of glycosides was established by the formation of a purple ring beneath and a brown ring at the interface.

Phlobatannins:
In order to treat 2 mL of extract, 5 mL of water and 1 mL of hydrochloric acid were added. The existence of phlobatannins was verified by a maroon precipitate.

Quinones:
After boiling 2 mL of the extract with 10 mL of sulfuric acid, it was filtered. After shaking the filtrate with 5e mL of chloroform, one milliliter of diluted ammonia was added. Quinones were recognized by a change in color in the chloroform layer.

Oxalates:
A few drops of acetic acid were added to 2 mL of extract. Oxalates were denoted by a brown or charcoal tint.

3. Result and Discussion

3.1. Physicochemical Analysis

Impatiens balsamina leaf physicochemical examination was carried out to evaluate its moisture content, ash values, extractive values, and other important parameters, as listed in Table 1. The results provide insight into the chemical composition and potential utility of the leaf for various applications. The ash values represent the inorganic content of the leaf, which is important for determining the total mineral content and the presence of impurities. With a total ash value of 6.45 g/100 g, the leaf's overall inorganic material content was determined. Acid soluble ash, which reflects the portion of ash soluble in acids and hence the easily available minerals, was recorded at 2.18 g/100 g. Conversely, the acid insoluble ash value, 4.27 g/100 g, suggests the presence of siliceous materials, which may include impurities such as soil and silica from plant tissues. There is a significant amount of water-soluble minerals and compounds in the ash, as evidenced by the water soluble ash content of 5.36 g/100 g. The existence of siliceous impurities that do not dissolve in water was further corroborated by the water insoluble ash, which had a concentration of 1.09 g/100 g. Additionally, the sulphated ash value was determined to be 3.15 g/100 g, which helps to quantify the content of sulphates and other thermally stable minerals. The extractive values are indicative of the soluble active constituents in the leaf, providing an estimate of the phytochemicals that can be obtained using specific solvents. The alcohol soluble extractive value was recorded at 18.95 g/100 g, suggesting a significant presence of alcohol-soluble compounds such as phenolics, flavonoids, and other organic compounds. The water soluble extractive value was higher, at 26.87 g/100 g, indicating a larger quantity of water-soluble constituents such as sugars, tannins, and glycosides. These values suggest that *I. balsamina* leaf contains a broad spectrum of phytochemicals, many of which may be bioactive and beneficial. The moisture content, measured as loss on drying, was found to be 5.72 g/100 g. Since the leaf material has a low moisture content, this low value means that it can be stored for an extended period of time with little chance of microbial growth. A lower moisture content also signifies a higher concentration of solid constituents, which could enhance its utility in extract preparation and formulations. The organic foreign matter (OFM) content, representing non-plant materials such as dirt or foreign plant matter, was found to be 7.21 g/100 g, which reflects a need for proper cleaning and processing of the raw material to remove extraneous substances. The dry matter (DM) content, calculated as 73.41 g/100 g, further demonstrates the high solid content of the leaf, supporting its potential for producing concentrated extracts. Bulk density (BD) was recorded at 13.25 g/100 g, providing insight into the compactness and handling properties of the powdered leaf material. This parameter is relevant for formulation development, as higher bulk density can facilitate easier handling and processing. Overall, the physicochemical analysis of *I. balsamina* leaf reveals valuable information regarding its ash composition, extractive potential,

moisture content, and bulk properties. These findings are critical for evaluating its suitability for use in phytochemical extraction, medicinal applications, and product development.

Table 1. Physicochemical Analysis of *Impatiens balsamina* Leaf

S. N.	Parameter	Values (g/100g)
1	**Ash Values**	
	Total ash (TA)	6.45
	Acid soluble ash (ASA)	2.18
	Acid insoluble ash (AIA)	4.27
	Water soluble ash (WSA)	5.36
	Water insoluble ash (WIA)	1.09
	Sulphated ash	3.15
2	**Extractive Values**	
	Alcohol extractive	18.95
	Water extractive	26.87
3	**Moisture Content**	
	Loss on drying	5.72
4	**Other Parameters**	
	Organic Foreign Matter (OFM)	7.21
	Dry Matter (DM)	73.41
	Bulk Density (BD)	13.25

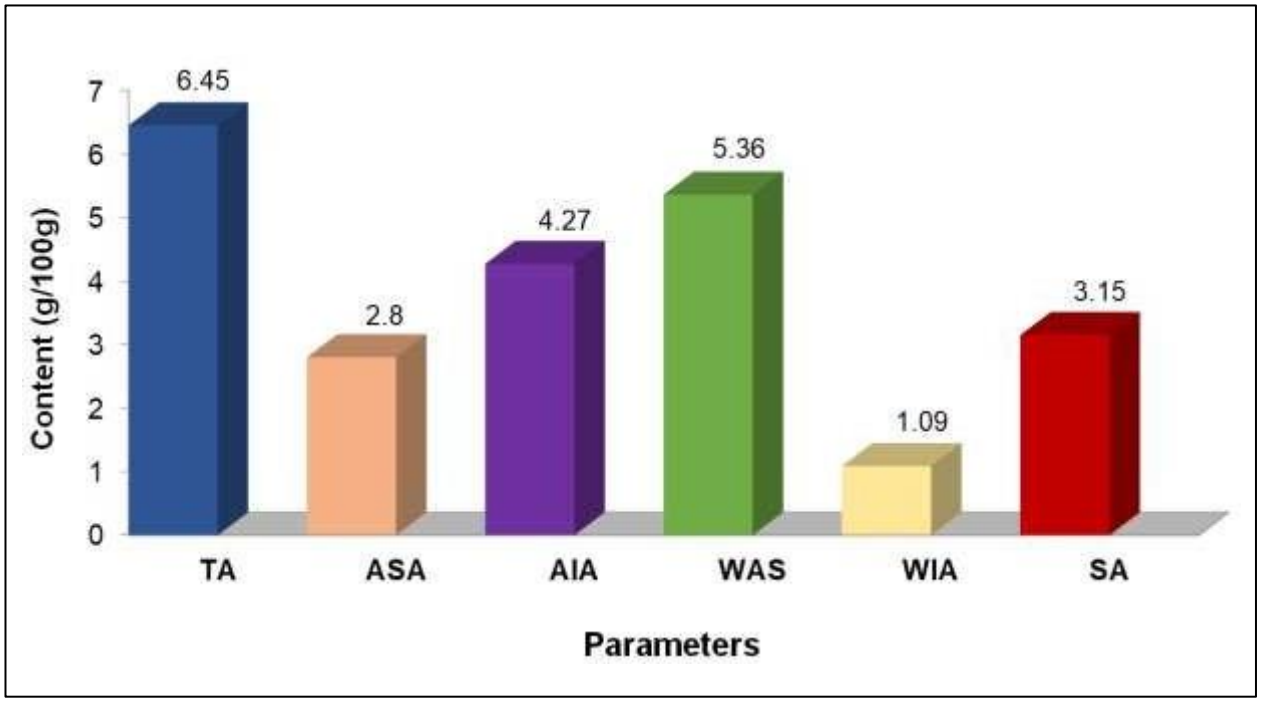

Fig. 2 Ash values of *I. balsamina* leaf. TA= Total ash, ASA= Acid soluble ash, AIA= Acid insoluble ash, WSA= Water soluble ash, WIA= Water insoluble ash, SA= Sulfated ash.

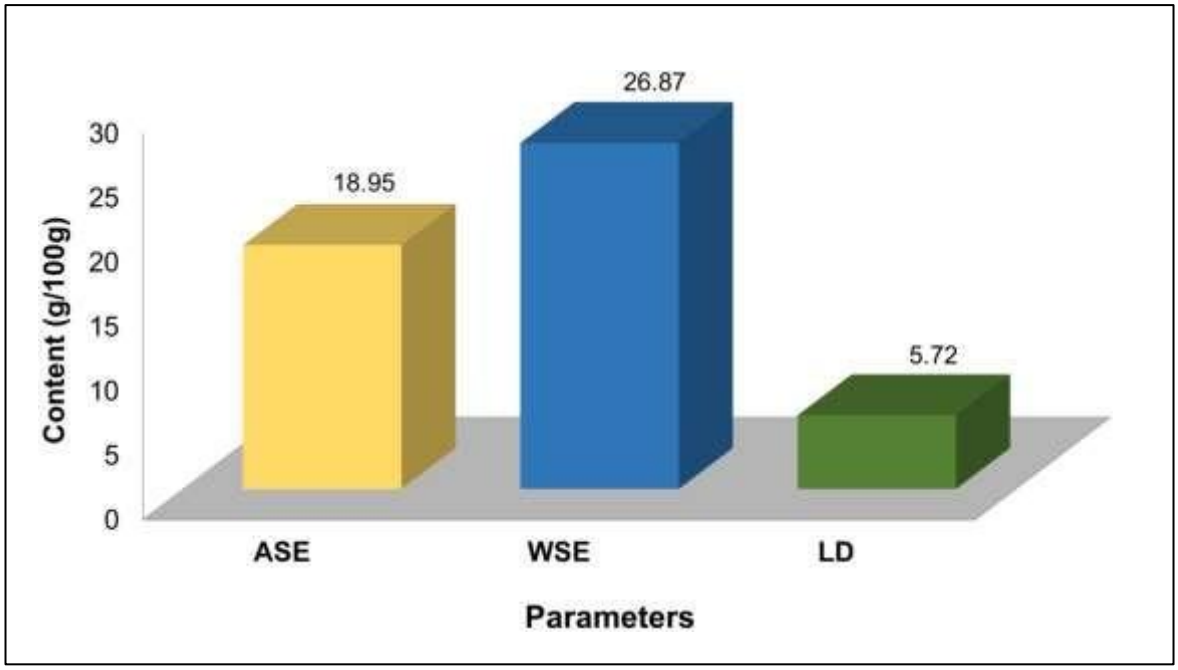

Fig. 3 Extractive values and LOD of *I. balsamina* leaf. ASE = Alcohol soluble extract value, WSE = Water soluble extract value, LD = Loss on drying.

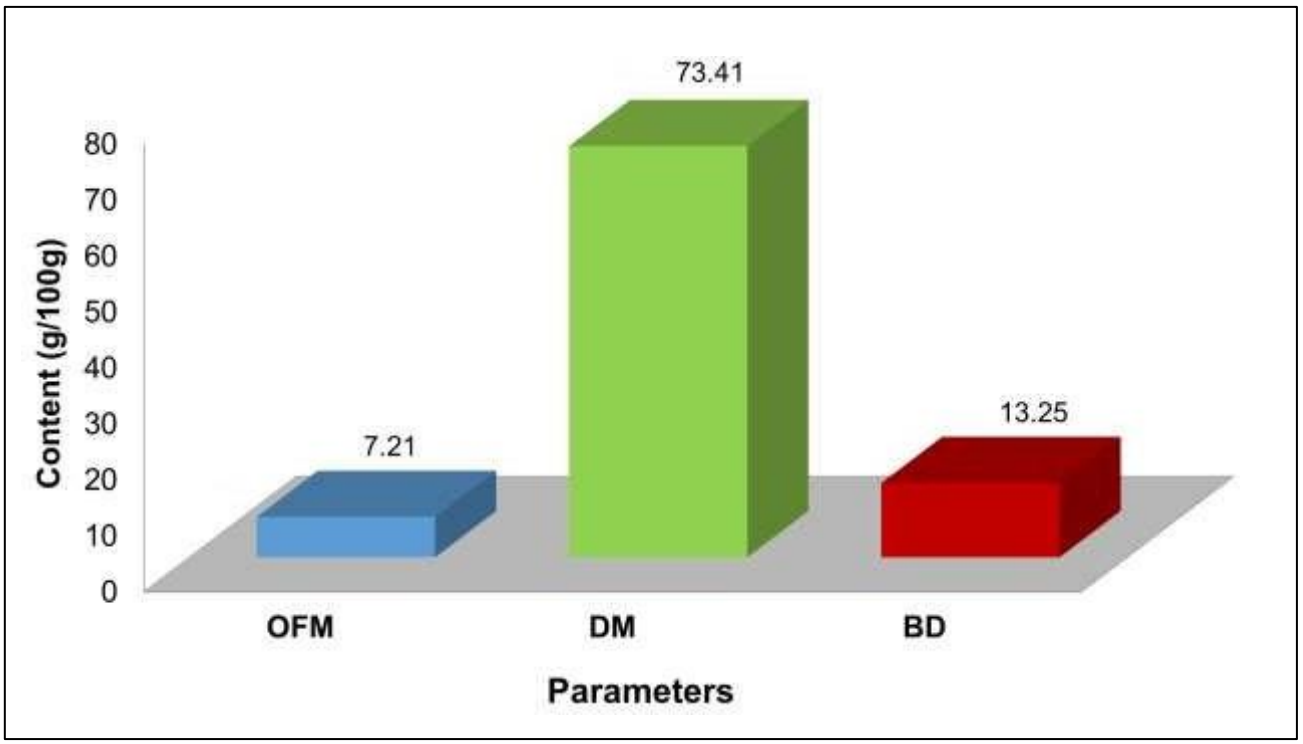

Fig. 4 Other parameter of *I. balsamina* leaf, OFM = Organic foreign matter, DM = Dry matter, BD = Bulk density.

Organoleptic Analysis

The organoleptic properties of *Impatiens balsamina* leaf were evaluated based on physical and sensory characteristics, providing insight into its morphological and sensory attributes. The observations are summarized in Table 2. The leaves of *I. balsamina* were processed into a fine powder, allowing for a more consistent and detailed sensory evaluation. The fine powder exhibited a light green hue, characteristic of processed herbal materials, which may be indicative of the presence of chlorophyll and other phytochemicals in the leaf tissue. Upon tactile assessment, the leaf powder presented a fine and smooth texture, suggesting successful drying and grinding

processes, which also indicate its suitability for further phytochemical or medicinal preparations. The taste profile of the leaf powder was slightly bitter. This bitter taste is frequently linked to secondary metabolites, which are found in many therapeutic plants and include alkaloids and glycosides. A mild leafy aroma was noted during the olfactory evaluation. This subtle fragrance aligns with the natural scent of plant materials, indicating minimal loss of volatile compounds during the drying process. Although the leaf material was ground into a powder, the original leaf shape—oval and slightly curved—was observed in the intact samples prior to grinding. This morphological feature is characteristic of *I. balsamina* leaves. The organoleptic analysis offers the fundamental knowledge required for *I. balsamina* leaf material identification and quality control, which is necessary for its use in herbal formulations and additional research.

Table 2. Organoleptic Analysis Results of *Impatiens balsamina* Leaf.

S. N.	Character	Observation
Sample form Fine powder		
1	Colour	Light green
2	Texture	Fine powder
3	Taste	Slightly bitter
4	Odour	Mild leafy aroma
5	Shape	Oval and slightly curved

3.2 Phytochemicals Screening

An extensive array of bioactive chemicals was found in the *Impatiens balsamina* leaf extract after preliminary phytochemical screening in different solvents. The investigation was carried out using different polarity solvents, as listed in Table 3, such as petroleum ether, dichloromethane (DCM), trichloromethane (TCM), acetone, ethyl acetate (EA), ethanol (EtOH), methanol (MeOH), and water. Flavonoids were abundantly present across the majority of solvents, particularly in methanol, where a strong positive reaction (+++) was observed, followed by ethanol and water (++) and acetone (+). Non-polar solvents like petroleum ether and DCM showed no presence of flavonoids (-). Alkaloids demonstrated the highest presence in ethanol (+++), with moderate amounts in methanol and water (++), and lower amounts in DCM, TCM, acetone, and EA (+). Alkaloids were absent in petroleum ether (-), highlighting the importance of polar solvents in their extraction. Terpenoids showed a broad distribution across solvents, with methanol and trichloromethane (TCM) exhibiting the strongest presence (+++). Moderate amounts were noted in acetone, EA, and DCM (++), with even the non-polar petroleum ether showing a weak presence (+). Steroids were present moderately in ethanol and methanol (++), while other solvents like DCM, TCM, acetone, and EA had a lower but consistent presence (+). Petroleum ether exhibited no presence of steroids (-). Phenols were highly abundant in both DCM and EA (+++), with methanol, ethanol, and TCM also showing a strong presence (++). Lower quantities were found in water and acetone, and petroleum ether demonstrated only a moderate amount (++). Sterols were primarily detected in ethanol, methanol, and water (+), while other solvents, including non-polar petroleum ether, DCM, TCM, acetone, and EA, showed no detectable sterols (-). Saponins were present abundantly in ethanol (+++), methanol (++), and water (+++), with acetone and EA showing moderate presence (+). Non-polar solvents, including petroleum ether and DCM, showed no detectable levels (-). Tannins exhibited moderate presence in DCM (++), water (++), and ethanol (++), while lower quantities were detected in TCM, acetone, and EA (+). Petroleum ether showed only a weak presence (+). Amino Acids were most abundant in methanol and water (++), followed by acetone and TCM (+). Petroleum ether, DCM, and EA did not show any presence (-). Carbohydrates were highly present in ethanol, methanol, and EA (+++), with moderate amounts in acetone, DCM, and TCM (++), and weak presence in petroleum ether (+). This indicates the versatility of solvents in extracting carbohydrates. Glycosides showed the strongest presence in methanol and water (+++), followed by ethanol (++). Acetone and EA showed moderate presence (+), while petroleum ether, DCM, and TCM revealed no detectable levels (-). Phlobatannins and quinones were absent in all tested solvents

(-), indicating their absence in *I. balsamina* leaf extracts. Oxalates showed moderate presence in methanol and water (++), while EA and acetone displayed a weak presence (+). Other solvents, including petroleum ether, DCM, and TCM, lacked any oxalates (-). the phytochemical screening indicated that *I. balsamina* leaves are a rich source of flavonoids, alkaloids, terpenoids, phenols, and saponins, particularly when extracted using polar solvents like methanol, ethanol, and water. These findings highlight the diverse phytochemical profile of *I. balsamina* and its potential for therapeutic applications.

Table 3. Preliminary Phytochemical analysis of *Impatiens balsamina* Leaf.

S.N.	Phytochemicals	Pet. Ether	DCM	TCM	Acetone	EA	Ethanol	Methanol	Water
1.	Flavonoids	-	-	+	++	+	++	+++	++
2.	Alkaloids	-	+	+	+	+	+++	++	++
3.	Terpenoids	+	++	+++	++	++	+++	+++	++
4.	Steroids	-	+	+	+	+	++	++	+
5.	Phenol's	+ +	+ + +	+ +	+ +	+++	+ + +	+ + +	+ +
6.	Sterol	-	-	-	-	-	+	+	+
7.	Saponins	-	-	++	+	+	+++	++	+++
8.	Tannins	+	++	+	+	+	++	+	++
9.	Amino Acids	-	-	+	+	-	+	++	++
10.	Carbohydrates	+	++	++	++	+++	+++	+++	++
11.	Glycosides	-	-	-	+	+	++	+++	+++
12.	Phlobatannins	-	-	-	-	-	-	-	-
13.	Quinones	-	-	-	-	-	-	-	-
14.	Oxalates	-	-	-	+	+	+	++	++

DCM = Dichloromethane, TCM = Trichloromethane, EA = Ethyl acetate

Conclusion

The physicochemical and phytochemical analysis of *Impatiens balsamina* leaf offers valuable insights into its chemical composition and potential utility in medicinal and industrial applications. The analysis of ash content, extractive values, and loss on drying confirmed the plant's purity and quality, with ash values indicating an acceptable level of inorganic materials. The presence of both water- and alcohol-soluble extractives suggests a rich profile of hydrophilic and lipophilic compounds, which may contribute to a range of pharmacological activities. Many bioactive constituents with antioxidant, antimicrobial, and anti-inflammatory properties were found through phytochemical screening, such as tannins, alkaloids, phenols, flavonoids, and terpenoids. The plant's diverse range of therapeutic potential was also highlighted by the discovery of carbohydrates, quinones, and phlobatannins. Low moisture content further supports the stability and efficacy of its bioactive compounds. Together, these findings provide a strong foundation for the exploration of *I. balsamina* in traditional medicine and beyond. Future research should focus on isolating specific phytochemicals and evaluating their biological activities to fully harness the therapeutic benefits of this versatile plant.

Conflict of interest
No conflicts need to be reported.

Supporting information
Not applicable.

Reference

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