# STANDARDIZATION OF *ĒLĀTI CŪRAṆAM*: A SIDDHA POLYHERBAL FORMULATION FOR HYPERTENSION

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**Abstract:**

**Background:** A poly herbo-mineral Siddha formulation, *Ēlāti Cūraṇam* (EC) has long been utilised as an anti-hypertensive medication. Physical and biochemical analyses are required to validate its therapeutic potential despite its widespread usage in Siddha medicine to guarantee its safety and effectiveness. **Objective:** The purpose of this study was to evaluate the heavy metal concentration of *Ēlāti Cūraṇam* and examine its physicochemical, phytochemical, and biochemical characteristics to confirm its safety profile. **Results:** Water-soluble ash (0.99%), acid-insoluble ash (1.5%), total ash value (5.47%), loss on drying (9.61%), water-soluble extractive (21.6%), and alcohol-soluble extractive (16%) were the results of the physicochemical analysis. Proteins, diterpenes, quinones, gum, mucilage, alkaloids, glycosides, Saponins, phenols, and flavonoids were all detected by phytochemical screening. Biochemical study identified basic radicals including potassium, calcium, magnesium, ammonium, sodium, and zinc, as well as acid radicals like sulphate and chloride. Safety was ensured by heavy metal analysis using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), which verified that levels of heavy metals were below allowable bounds. *Ēlāti Cūraṇam 's* physicochemical, phytochemical, and biochemical qualities are confirmed by the results, which also show that it complies with heavy metal safety regulations. These findings offer scientific proof in favour of its long-standing application in Siddha medicine as an anti-hypertensive formulation.

**Keywords:** *Ēlāti Cūraṇam*, *Siddha*, Standardization, Physico-chemical, Phytochemical, Acid radical, Basic radical.

## 1. INTRODUCTION

One of the oldest medicinal traditions from South India that has received international prominence is the Siddha system. Unfortunately, microbial and metal adulterants can contaminate Siddha formulations, frequently because of insufficient raw medication purification. Heavy metals have been shown to affect cellular organelles and components in biological systems, such as the nucleus, mitochondria, lysosomes, endoplasmic reticulum, cell membrane, and many enzymes involved in metabolism, detoxification, and damage repair[1]. A drug's standardisation is essential for assessing its potency and effectiveness using a variety of analyses. It entails confirming the drug's usage as a medication through extensive research to evaluate its efficacy and quality. This procedure entails determining the medication's active ingredients and principles and assessing its physical, phytochemical, and organoleptic qualities. Ultimately, standardization guarantees the drug's potency and effectiveness, proving its appropriateness for medical usage. WHO standards state that before an herbal product is put on the market, its safety must be standardized. This entails making certain that the product satisfies accepted safety requirements and is devoid of dangerous impurities, assuring customer safety[2]. Standardizing polyherbal formulations guarantees that each dose has a fixed number of components, preserving predefined medicinal effects, quality, and quantity. This technique is essential for ensuring the formulation's dependability and effectiveness in providing the desired therapeutic effects[3]. The purpose of this research is to assess the standardization of *Ēlāti Cūraṇam,* a traditional Siddha medication formulation that is given for hypertension.

## 2. MATERIAL AND METHODS

### 2.1. Ingredients and procedure of *Ēlāti Cūraṇam*

The ingredients used in *Ēlāti Cūraṇam* include *Elettaria cardamomum* seeds, dried flowers of *Nelumbo nucifera and Nymphaea nouchali, Cyperus rotundus* rhizome, *Glycyrrhiza glabra* root, *Syzygium aromaticum* flower, *Ziziphus mauritiana* seed, *Dryobalanops aromatic* supplement, and fried paddy of *Oryza sativa*. These components are first purified according to Siddha literature[4], then dried in the shade until all moisture is completely evaporated. Each ingredient is individually roasted, powdered, and filtered before being thoroughly mixed to create the final formulation, *Ēlāti Cūraṇam.*

### 2.2. Organoleptic Character

One gram of the test substance was examined to assess the sample drug's organoleptic properties. Under the sun, the colour, odour, taste, texture, particle size, and other morphological characteristics were all visible to the unaided eye, and the outcomes were noted appropriately[5].

### 2.3. Physicochemical Analysis

The Tamilnadu Dr. M.G.R. Medical University at Anna Salai, Guindy, conducted physicochemical studies on solubility, pH value, loss upon drying at 105°C, and ash content. The World Health Organization's (WHO) recommendations were followed for conducting these tests[6].

**Solubility:**

The solvent was poured into a dry test tube along with a pinch of EC. The combination was vigorously agitated for approximately one minute, after which the outcomes were noted. Toluene, benzene, chloroform, distilled water, ethanol, petroleum ether, propylene glycol, ethyl alcohol, xylene, and carbon tetrachloride were among the solvents used in this experiment. Individual observations were made for each solvent.

**pH value:**

A glass electrode and an appropriate pH meter were used to potentiometrically measure the pH of EC. The EC's pH reading was then noted in the results column.

**Loss on Drying:**

A precisely weighed 1 gram of the EC formulation was put in a tarred glass container to measure its moisture content. After that, the sample was cooked for six hours at 105°C in an oven until its weight remained constant. The shade-dried material was used to compute the sample's % moisture content.

**Determination of total ash:**

A precisely weighed 2 grams of the EC formulation was put in a crucible to measure its total ash content. The sample was burned to 600°C in a muffle furnace to produce carbon-free ash. Next, the total ash content was determined using the medication that had been air-dried.

**Determination of acid-insoluble ash:**

An ash-less filter paper was used to filter the resulting ash after it had been heated for five minutes with 25 millilitres of 1M hydrochloric acid. After being cleaned with hot water to remove any remaining insoluble material, the filter paper was burnt in a muffle furnace until its weight remained constant. The air-dried medication was used to calculate the proportion of acid-insoluble ash.

**Determination of water-soluble ash:**

One gram of total ash was cooked with twenty-five millilitres of water for five minutes to ascertain the amount of soluble ash. After gathering the insoluble material on ash less filter paper and cleaning it with hot water, it was fired in a muffle furnace for 15 minutes at a temperature of no more than 450°C. Drying the filtrate from the filtration procedure allowed for the calculation of the amount of soluble ash.

**Determination of water-soluble Extractive:**

Five grams of coarsely ground air-dried *Ēlāti Cūraṇam* were macerated with one hundred millilitres of distilled water in a closed flask for twenty-four hours, with regular shaking, to identify the water-soluble extractive. After filtering the mixture, 25 millilitres of the filtrate were evaporated in a shallow dish with a flat bottom and tar. After being further dried at 100°C, the residue was weighed. Using the air-dried medication as a reference, the percentage of water-soluble extractives was computed.

**Determination of alcohol soluble extractive:**

One gram of coarsely ground air-dried *Ēlāti Cūraṇam* was macerated with twenty millilitres of alcohol in a closed flask for twenty-four hours, shaking frequently, to identify the alcohol-soluble extractive. After that, the liquid was quickly filtered while being careful not to lose any alcohol. Ten

millilitres of the filtrate were evaporated in a shallow dish with a flat bottom, dried at 100°C, and weighed. Using the air-dried medication as a reference, the proportion of alcohol-soluble extractives was determined.

### 2.4. Phytochemical Analysis

An overview of the types of chemical components found in crude medicine is given by the phytochemical screening of the extract. The phytochemical assays were carried out using the procedures specified[7].

**Detection of alkaloids:**

Dragendorff's reagent, a potassium bismuth iodide solution, was applied to the filtrate of the dissolved sample in diluted hydrochloric acid to check for the presence of alkaloids in EC. Alkaloids can be detected by the production of a crimson precipitate.

**Detection of carbohydrates:**

Benedict's reagent was added to the filtrate that had been dissolved in 5 millilitres of distilled water, and it was then slowly heated to check for the presence of carbohydrates in EC. There are reducing sugars present when an orange-red precipitate forms.

**Detection of glycosides:**

To check for glycosides in EC, the sample was first hydrolysed using diluted hydrochloric acid. After hydrolysis, the Keller-Killiani technique was used to check for cardiac glycosides in the sample. The procedure is as follows: The hydrolysed sample was shaken with five millilitres of distilled water. Two millilitres of glacial acetic acid were mixed with a few drops of ferric chloride. Concentrated sulphuric acid ($H_2SO_4$) was then carefully added in 1 ml down the side of the test tube. A positive outcome for cardiac glycosides is indicated by the formation of a brown ring at the interface, maybe followed by a violet ring.

**Detection of Saponins**

Use 20 millilitres of distilled water to dilute the sample. For fifteen minutes, vigorously shake the liquid in a graduated cylinder. There are Saponins present when a 1 cm layer of foam forms.

**Detection of phenols Ferric Chloride Test:**

Apply three to four drops of ferric chloride solution to the extracts. The presence of phenols is indicated by the creation of a bluish-black colour.

**Detection of tannins Gelatine Test:**

Dissolve the extract in five millilitres of distilled water. Add 2 millilitres of a 1% gelatine solution with 10% NaCl to the mixture. The development of a white precipitate indicates the presence of phenolic chemicals.

**Detection of Flavonoids**

**a) Alkaline Reagent Test:** The EC was mixed with a few drops of sodium hydroxide solution. The presence of flavonoids is indicated by the development of a brilliant yellow colour that goes colourless when diluted acid is added.

**Detection of Proteins**

**a) Xanthoprotein Test:** A few drops of strong nitric acid were applied to the EC. The presence of proteins is indicated by the formation of a yellow colour.

**Detection of Amino Acids**

**a) Ninhydrin Test:** After adding 0.25% w/v ninhydrin reagent to the EC, the mixture was brought to a boil for a short while. The presence of amino acids is shown by the production of a blue colour.

**Detection of Diterpenes**

**a) Copper Acetate Test:** The EC was dissolved in water and treated with 3-4 drops of copper acetate solution. The appearance of an emerald green colour indicates the presence of diterpenes.

**Detection of Gum and Mucilage**

2.5 ml of pure alcohol was added to 1 ml of EC while being continuously stirred. Following air drying, the precipitate's swelling characteristics were investigated. Swelling is an indication that mucilage and gum are present.

**Test for Quinones**

The sodium hydroxide was used to treat the EC. When quinones are present, a blue or crimson precipitate will occur. Check for fats and fixed oils.

**Spot Test:** Two filter sheets were sandwiched by a tiny quantity of EC. The presence of fixed oils is indicated by the formation of an oil stain on the paper.

**2.5. Bio-Chemical Analysis**

**Preliminary Basic and Acidic Radical Studies [8]**

**Preparation of Extract**

50 millilitres of distilled water were introduced to a 250 millilitre clean beaker containing five grams of EC. After around ten minutes of boiling, the liquid was allowed to cool. After filtering it into a 100 ml volumetric flask, distilled water was added to get the volume up to 100 ml. The acidic/basic radicals and biological components were qualitatively analysed using this solution.

**Test for Basic Radicals**

**Test for Potassium:**

Two millilitres of sodium nitrate and two millilitres of cobalt nitrate solution in 30% glacial acetic acid were combined with a pinch of the EC. Potassium is indicated by the presence of a yellow precipitate.

**Test for Calcium:**

Two millilitres of a 4% ammonium oxalate solution were added to two millilitres of the EC extract. Calcium is indicated by the production of a white precipitate.

**Test for Magnesium:**

Drops of sodium hydroxide solution were added to 2 millilitres of the EC extract. Magnesium is indicated when a white precipitate forms.

**Test for Ammonium:**

A few millilitres of Nessler's reagent and an excess sodium hydroxide solution were added to two millilitres of the EC extract. Ammonium is indicated by the presence of a brown colour.

**Test for Sodium:**

Hydrochloric acid and a pinch of EC were combined to create a paste, which was then added to a Bunsen burner's blue flame. Sodium is indicated by the development of a bright yellow colour.

**Test for Iron (Ferrous):**

Both ammonium thiocyanate and concentrated nitric acid were used to treat the EC extract. Iron (ferrous) is indicated by the appearance of a blood red colour.

**Test for Zinc:**

Drops of sodium hydroxide solution were added to 2 millilitres of the EC extract. Zinc is indicated by the production of a white precipitate.

**Test for Aluminium:**

Drops of sodium hydroxide were added to 2 millilitres of the EC extract, and any alterations were recorded. Certain reactions or precipitates will show the presence of aluminium.

**Test for Lead:**

Two millilitres of potassium iodide solution were added to two millilitres of the EC extract. Lead is indicated by the formation of a yellow-coloured precipitate.

**Test for Copper:**

Using strong hydrochloric acid on a watch glass, a pinch of EC was ground into a paste and added to the flame's non-luminous area. Copper is indicated by the development of a blue colour. The excess ammonia solution was added to 2 millilitres of the EC extract. Copper is indicated by the production of a blue-coloured precipitate.

**Test for Mercury:**

The sodium hydroxide solution was added to 2 millilitres of the EC extract. Mercury is indicated by the presence of a yellow precipitate.

**Test for Arsenic:**

Two millilitres of sodium hydroxide solution were added to two millilitres of the EC extract. Arsenic is present when a red or brown precipitate forms.

**TEST FOR ACID RADICALS**

**Test for Sulphate:**

Two millilitres of the EC extract were mixed with a 5% barium chloride solution. In the presence of sulphate, a white precipitate will develop.

**Test for Chloride:**

A solution of silver nitrate was used to treat the EC extract. A white precipitate's development suggests that chloride is present.

**Test for Phosphate:**

Ammonium molybdate and concentrated nitric acid were used to treat the EC extract. The presence of phosphate is indicated by the formation of a yellow precipitate.

**Test for Carbonate:**

Hydrochloric acid that was concentrated was used to treat the EC extract. The presence of carbonate is indicated by the sight of effervescence, or froth.

**Test for Fluoride and Oxalate:**

After adding two millilitres of diluted acetic acid and two millilitres of calcium chloride solution to two millilitres of the EC extract, the mixture was boiled. There is fluoride and/or oxalate present when a hazy look forms.

**Test for Nitrate:**

Concentrated sulphuric acid was applied after copper turnings were added to 1 gram of EC. The test tube was angled downward vertically while the liquid was heated. Nitrate may be present if any alterations are noticed.

**ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometry)**

**Manufacturer:** Perkin Elmer

**Model:** Optima 5300 DV ICP-OES Spectrometer

**Principle:**

This method uses a nebulizer to turn an aqueous sample into aerosols. The inductively coupled plasma (ICP), a high-temperature environment that may reach 8,000–10,000°C, is where these aerosols are injected. Analyses are stimulated to various atomic and ionic states in this plasma, which results in the emission of distinctive optical signals, or light. A spectrometer is used to measure the intensity of the emitted light after it has been separated by wavelength. The intensity and the analyse concentration in the sample have a direct correlation. By comparing the emission intensity of the sample to that of standard solutions—which are made from single- and multi-element primary standards—external calibration is employed for quantification. ICP-OES gives the whole elemental concentration, in contrast to techniques that need chemical speciation (e.g., differentiating between ferrous and ferric iron).

**Application:**

For EC analysis with great accuracy of main and minor elements in solution.

**Objectives:**

- Find out how much of each metal there is.
- Recognize how the ICP-OES instrument works and its underlying concepts.
- Create and put into practice a technique for ICP-OES sample analysis.
- Optimize the conditions of the instruments used for the analysis of various elements. Examine the atoms' external electronic structure.

**Mechanism:**

An EC solution is injected into the center of an inductively coupled argon plasma (ICP), which reaches temperatures of around 8,000°C, in order to perform Plasma Emission Spectroscopy (OES). Every element becomes thermally stimulated and releases light with distinct wavelengths at this temperature. After being captured by a spectrometer, the light is dispersed into its individual wavelengths by passing it through a diffraction grating. After then, the spectrometer gathers and intensifies the light according to its wavelength, generating a detectable signal that, when compared to calibration standards, may be translated into elemental quantities[10].

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The PerkinElmer Optima 5300 DV apparatus was used to conduct the Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) analysis at the Sophisticated Analytical apparatus Facility (SAIF), IIT Madras, Chennai-36.

## 3. RESULTS

### Organoleptic Characters

Because it is made from dried herbs, EC has a yellowish-green colour, which is one of its organoleptic qualities. It has a bittersweet flavour that might be part of its medicinal properties. The medication looks like a fine powder.

### Physico-Chemical Analysis

Data on factors including pH, solubility, moisture loss during drying, total ash content, water-soluble ash, and acid-insoluble ash are obtained from the drug's physicochemical examination (as indicated in Table 1).

**Table no 1. Results of Physico chemical analysis of *Ēlāti Cūraṇam***

| S.No | Parameter | Result |
|---|---|---|
| 1. | $P^H$ | 4.24 |
| 2. | Solubility | Positive |
| | Distilled water | Soluble |
| | Benzene | Soluble |
| 3. | Loss on drying | 9.61% |
| 4. | Total ash value | 5.47% |
| 5. | Acid insoluble Ash (%) | 1.5% |
| 6. | Water-soluble ash (%) | 0.99% |
| 7. | Water soluble extraction | 21.6% |
| 8. | Alcohol soluble extraction | 16% |

**Table no 2. Results of phytochemical analysis of *Ēlāti Cūraṇam***

Naturally present bioactive substances in plants and fibres, phytochemicals serve as a defensive mechanism against illnesses and offer protection from a range of ailments. The phytochemical analysis (Table 2) indicates the presence of proteins, diterpenes, alkaloids, glycosides, Saponins, phenols, flavonoids, gums, and mucilage.

| S.no | Phytochemicals | Test name | Result |
|---|---|---|---|
| 1. | Alkaloids | Dragendroff's Test | +ve |
| 3. | Glycoside | Keller-Killiani Test | +ve |
| 4. | Saponin | Froth Test | +ve |

| | | | |
|---|---|---|---|
| 5. | Phenols | Ferric chloride Test | +ve |
| 7. | Flavanoids | Alkaline Reagent test | +ve |
| 8. | Proteins | Xanthoproteins Test | +ve |
| 10. | Diterpines | Copper Acetate Test | +ve |
| 11. | Gum and Mucilage | Extract +Alcohol | +ve |
| 12. | Quinones | NAOH+Extract | +ve |

**+ve/-ve present or absent if component tested.**

**Biochemical Analysis:**

**Table 3. Results of Basic Radical Studies of *Ēlāti Cūraṇam***

The following elements are confirmed to be present by the basic radical test findings (Table 3): potassium ($K^+$), calcium (Ca), magnesium (Mg), sodium (Na), and zinc (Zn).

| S. No | Parameter | Observation | Result |
|---|---|---|---|
| 1. | Test for Potassium | Formation of yellow colour precipitate | Positive |
| 2. | Test for Calcium | Formation of white colour precipitate | Positive |
| 3. | Test for Magnesium | Formation of white colour precipitate | Positive |
| 4. | Test for Ammonium | Appearance of brown colour | Positive |
| 5. | Test for Sodium | Appearance of intense yellow colour | Positive |
| 6. | Test for Zinc | Formation of white colour precipitate | Positive |

**Table no 4. Results of Acid Radical Studies of *Ēlāti Cūraṇam***

The presence of nitrate and chloride is indicated by the acidic radical test findings (Table 4).

| S.NO | Parameter | Observation | Result |
|---|---|---|---|
| 1. | Test for Sulphate | Appearance of white precipitate | Positive |
| 2. | Test for Chloride | Formation of white precipitate | Positive |

**ICP-OES (Inductively Coupled Plasma Optic Emission Spectrometry):**

Heavy elements like Arsenic (As), Cadmium (Cd), Mercury (Hg), and Lead (Pb) were found to be below detectable levels, according to the ICP-OES data (Table 5). This suggests that the medication is safe and uncontaminated by these heavy metals.

**Table No 5. Results of ICP-OES**

| S. No | Elements Symbol | Wavelength (nm) | Concentration |
|---|---|---|---|
| 1. | Aluminium (Al) | 396.152 | BDL |
| 2. | Arsenic (As) | 188.979 | BDL |
| 3. | Calcium (Ca) | 315.807 | 13.105 mg/L |
| 4. | Cadmium (Cd) | 228.802 | BDL |
| 5. | Copper (Cu) | 327.393 | BDL |
| 6. | Iron (Fe) | 238.204 | 01.004 mg/L |
| 7. | Mercury (Hg) | 253.652 | BDL |
| 8. | Magnesium (Mg) | 285.213 | 01.274 mg/L |
| 9. | Sodium (Na) | 589.592 | 34.801 mg/L |
| 10. | Nickel (Ni) | 231.604 | BDL |
| 11. | Lead (Pb) | 220.353 | BDL |
| 12. | Phosphorous (P) | 213.617 | 98.107 mg/L |

## 4. DISCUSSION

The chooranam's fineness suggests that it is easier to absorb and has better availability in the body. Several methods are used to lower the particle size, such as hammering, sifting, and filtering through white cloth (vasthirakayam). The medicine can only be efficiently absorbed in the digestive system when the particles are reduced to micro-sized. By following the procedures outlined, the chooranam is guaranteed to pass through sieve number 88, signifying the required particle size.

**Solubility:**

A drug's solubility is essential for reaching the target concentration in the bloodstream and producing the expected pharmacological effect. The most popular drug administration method, oral intake, greatly depends on solubility for efficient bioavailability. Chooranam dissolves readily in most solvents but rather weakly in others. Its solubility and, hence, bioavailability are improved by its good solubility in benzene and distilled water[11].

**pH:**

The pH level plays a major role in controlling homeostasis since it is essential for enzyme function and preserving the internal environment. At 4.24, EC has a weakly acidic pH. Weak acids are more soluble in water in alkaline solutions than lipids in acidic conditions. When a mild acid medication is taken, it generally stays in its un-ionized form in the stomach's acidic environment, which makes it easier for the gastric mucosa to absorb it. Therefore, compared to weakly basic medications, weakly acidic pharmaceuticals are more easily absorbed from the stomach's acidic medium. This pH-related characteristic12 improves the drug's bioavailability.

**Loss on drying**:

The overall quantity of moisture and volatile content in a medication is measured by Loss on Drying (LOD). The moisture content of a medication has a direct impact on its stability and shelf life. While a reduced moisture level often guarantees better stability and a longer shelf life, increased moisture might negatively impact the active components. With a moisture content of 9.61%, the EC exhibits little drying loss and is deemed appropriate for use in pharmaceutical preparation.

**Ash Content:**

Drug quality and purity are evaluated using ash values. Inorganic salts that are either naturally occurring or adherent to the medicine are usually included in the ash content, which is the residue that remains after cremation. Any inorganic material added through adulteration may also be reflected in it. Important details on the composition and purity of the medication are provided by the ash content[13]. *Ēlāti Cūraṇam* 's total ash value of 5.47% suggested that the medication included inorganic material. This figure aids in determining how much inorganic material remains after burning and helps assess the drug's quality and purity.

**Acid insoluble ash**:

**Total Ash:**

Total ash is the residue left over after the substance has been burned. The percentage of total ash that is insoluble in diluted hydrochloric acid is known as acid-insoluble ash. Because it demonstrates the lack of impurities like sand, dust, or stones, a lower acid-insoluble ash value denotes higher medicine quality. The acid-insoluble ash for *Ēlāti Cūraṇam* is 1.5%, indicating that the medication is devoid of these contaminants.

**Water-Soluble Ash:**

The quantity of ash that dissolves in water is indicated by the water-soluble ash value. Improved diffusion and osmosis mechanism facilitation is indicated by a lower value. *Ēlāti Cūraṇam* 's water-soluble ash content of 0.99% indicates that the medication has good qualities for promoting these activities.

**Water-Soluble and Alcohol-Soluble Extraction:**

*Ēlāti Cūraṇam* has a water-soluble extractive value of 21.6%, suggesting that water works better than alcohol as a solvent to remove ingredients from the formulation. Compared to the water-soluble value, the alcohol-soluble extractive value is lower at 16%. This indicates that water works well as a solvent for this formulation since the active ingredients, such as alkaloids, are more soluble in it than in alcohol.

**Alkaloids:**

Alkaloids are well-known for their anti-arrhythmic and vasodilatory properties. They are the main active ingredients of *Ēlāti Cūraṇam* , and they give the body vital protection[14].

**Glycosides**

Glycosides have antioxidant properties, which are important in the treatment of heart conditions. By scavenging free radicals and lowering oxidative stress, their antioxidant qualities support cardiovascular health and protect the heart[15].

**Saponin:**

Saponins bond with cholesterol and bile salts in the gastrointestinal system and lessen the emulsification of fat molecules. This interaction helps cholesterol be absorbed by forming tiny micelles with it. Saponins help lower blood cholesterol levels by blocking the reabsorption of cholesterol. Furthermore, Saponins have antioxidant qualities that lower the risk of heart disease even further[16].

**Phenols:**

Strong antioxidant qualities found in phenols aid in shielding the organism from oxidative stress. They are essential in protecting cells and tissues from oxidative damage because they neutralize free radicals[17].

**Diterpene:**

Diterpenes are good for lowering blood pressure because they contain vasorelaxant qualities and can prevent vasoconstriction. Diterpenes reduce blood pressure and improve cardiovascular health by relaxing blood vessels and inhibiting their constriction[18].

**Protein**

Diterpenes are essential for growth and help heal damaged cells. When compared to carbohydrate intake, increasing protein intake can reduce systolic blood pressure by more than 2 mmHg. It has been demonstrated that both plant and animal proteins lower blood pressure and considerably reduce the risk of high blood pressure. Alkaloids, glycosides, phenols, triterpenes, flavonoids, and quinones all work together to help the medication effectively treat hypertension[19,20].

**Flavonoids:**

One important class of polyphenolic chemicals present in plants is flavonoids. They fortify and shield the blood vessel's inner lining, improve endothelial and capillary function, and lower the risk of atherosclerosis. Flavonoids are plant metabolites that have antioxidant properties and signalling pathways in cells that promote health. By scavenging free radicals, chelating metal ions, and blocking the enzymatic systems that produce free radicals, they exhibit antioxidant action[21].

**Tannin:**

Antioxidant qualities found in tannins help shield the body and provide several positive impacts. They have an ACE (angiotensin-converting enzyme) inhibitory action, which aids in blood pressure management, and they can affect blood pressure and urine parameters[22].

**Quinones**

Because of their antioxidant properties, quinones can lower blood pressure and prevent cardiovascular illnesses. By scavenging free radicals and lowering oxidative stress, their activation helps to decrease blood pressure and promote cardiovascular health[23].

**Potassium**

Potassium is essential for muscular contraction, especially when it comes to blood vessel wall relaxation. This reduces cramping in the muscles and lowers blood pressure. Additionally, by promoting general cardiovascular function, sufficient potassium levels help prevent irregular heartbeats[24].

**Calcium:**

Skeletal tissue is physically stronger when calcium is present. Both nerve impulse transmission and muscle contraction depend on calcium ions. Additionally, by promoting blood vessel vasoconstriction and vasodilation, calcium is essential for sustaining appropriate blood pressure[25].

**Magnesium**

Magnesium helps to relax blood vessels and control blood pressure. It enhances endothelial function, raises nitric oxide levels, promotes vasodilation, and acts as a natural calcium channel

blocker. All of these actions work together to improve blood pressure control and cardiovascular health[26].

**Ammonium:**

Clinical outcomes in hypertensive renal disorders can be predicted by ammonium levels. Ammonia may enhance general vascular and cardiovascular health by increasing cerebral blood flow and promoting vasodilation.

**Sodium:**

Because sodium affects blood volume and fluid balance, it is essential for controlling blood pressure[27].

**Zinc:**

Zinc's antioxidant qualities assist general cellular health by shielding cells from harm brought on by free radicals[28].

**Sulphate:**

Sulphate is useful in treating pregnancy-related hypertension problems and is mostly utilized for its anticonvulsive properties[29].

**Chloride:**

Chloride is essential for balancing the extracellular fluid (ECF) and intracellular fluid (ICF) in cells and maintaining appropriate blood volume, blood pressure, and blood pH[30].

According to the ICP-OES data, the trial medication is incredibly safe and the levels of heavy metals are within predetermined bounds. Furthermore, the following elements are present in *Ēlāti Cūraṇam* at the designated concentrations: 13.105 mg/L of calcium (Ca); 1.004 mg/L of iron (Fe); 1.274 mg/L of magnesium (Mg); 34.801 mg/L of sodium (Na); and 98.107 mg/L of phosphorus (P)

## 5. CONCLUSION

Alkaloids, glycosides, Saponins, Phenols, Flavonoids, Proteins, Diterpenes, Gum, and Mucilage are among the many phytochemicals that make up *Ēlāti Cūraṇam*, a traditional Siddha composition that has shown great promise. Its medicinal qualities are a result of these substances as well as vital biochemical components including potassium, calcium, magnesium, sodium, zinc, chloride, and nitrate. *Ēlāti Cūraṇam's* safety has been verified by ICP-OES analysis, which showed that dangerous heavy metal levels are below detectable limits, guaranteeing that it is suitable for therapeutic usage. The formulation's bioactive ingredients, which are known to control blood pressure and promote cardiovascular health, make it particularly promising for the treatment of hypertension. Nevertheless, more investigation is necessary to fully assess its pharmacological efficacy and clarify its mode of action in hypertension and associated disorders. Thorough clinical research is required to prove *Ēlāti Cūraṇam's* effectiveness, expand its medicinal uses, and offer proof-based support for its traditional claims. These initiatives will open the door for its incorporation into contemporary healthcare systems and for its broader recognition as a secure and efficient treatment for hypertension.

6. **CONFLICT OF INTEREST:** The authors declare that there are no conflict of interest.
7. **SOURCE OF FUNDING:** None

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