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Research Article

# Analytical Profile of *Vruntaka Phala Beeja* (*Solanum melongena Linn. Seeds)*

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**Abstract:** *Vruntaka Phala* (*Solanum melongena Linn.*) is a well-known fruit vegetable available throughout the year in almost all parts of the country with diverse varieties. It has various nutritious as well as medicinal properties. In Ayurveda, it is mentioned as *pathyakara* (wholesome) in various disease conditions. As per modern dietetics, it is a rich source of dietary fibers and antioxidants which helps to prevent non-communicable diseases (NCDs') like cancer, heart disease, diabetes, and hyperlipidemia. *Solanum melongena* is ranked amongst the top ten vegetables providing low calories and high phenolic contents, which help absorbtion of free radicals from the body. Besides this, it contains arginine, aspartic acid, histidine, oxalic acid, solasodine, ascorbic acid, tryptophan, pyrrolidine, and quinolizidine as important pharmacological active ingredients. By these phytoconstituents, the plant possesses proven pharmacological activities like antipyretic, analgesic, antioxidant, anti-inflammatory, antiasthmatic, spasmogenic, hypolipidemic, antihypertensive, thrombolytic, antiplatelet, calcium channel blocking, etc. Using these pharmacological activities, the plant can be used medicinally in treating disease conditions like fever, inflammation, neuralgia, asthma, etc. After a meticulous study of published data, it was found that the phytochemical constituents of most of the parts of *Solanum melongena* with their pharmacological activities were evaluated. But the physicochemical and phytochemical profile of *Vruntaka Phala Beeja* was rarely explained. Hence the present study aims to evaluate the analytical profile of *Vruntaka Phala Beeja.* The objective of the present study is to be acquainted with the nutritional, pharmacological, and medicinal properties of *Solanum melongena.*

**Keywords:** *Vruntaka Phala, Solanum melongena Linn.,* Analytical Profile, Physicochemical Properties, Phytoconstituents

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## 1. INTRODUCTION

*Vruntaka Phala (Solanum melongena Linn.)* is commonly known as Brinjal or Eggplant. It is an herbaceous vegetable with a diverse variety throughout the year in almost all parts of the country. This plant belongs to the family Solanaceae, which contains 75 genera and over 2000 species.[1] Fruit is widely used in the diet. As per modern dietetics, though having comparatively low calories and fats, it is a rich source of dietary fibers and antioxidants which helps to prevent some non-communicable diseases (NCDs') like cancer, heart disease, diabetes, and hyperlipidemia.[2] On phytochemical screening, it was evident that fruits contain arginine, aspartic acid, histidine, oxalic acid, solasodine, ascorbic acid, tryptophan, etc.[3] Nasunin and Anthocyanin, an important phenolic compound are found in fruit peel.[4] Seeds contain steroidal saponins - melongoside L, M, N, O, P, R, S, T, U, V.[5,6] Leaves contain chlorogenic, hydrocaffeic, and protocatechuric acids.[7] A bioflavonoid glycoside named solanoflavone is present in the leaves and fruits.[8] Callus extract of Solanum melongena contains alkaloids, flavonoids, tannins, steroids, and glycosides.[9] Owing to these phytoconstituents, the plant possesses pharmacological activities like antipyretic, analgesic, antioxidant, anti-inflammatory, anti-asthmatic, spasmogenic, hypolipidemic, antihypertensive, anti-glaucomatous, anti-diabetic, anti-microbial, anti-anaphylactic, CNS depressant, thrombolytic, antiplatelet, calcium channel blocking, etc.[10-22] Hence using these properties, *Solanum melongena* is used as medicine in respective diseases. After a meticulous study of published data, it was found that the phytochemical constituents of most of the parts of *Solanum melongena* with their pharmacological activities were evaluated. But the physicochemical and phytochemical profile of *Vruntaka Phala Beeja* was rarely explained. Hence the present study aims to evaluate the analytical profile of *Vruntaka Phala Beeja.* The objective of the present study is to become acquainted with the nutritional, pharmacological, and medicinal properties of *Solanum melongena.*

### *1.1 Taxonomical Classification[23]:*

The taxonomical hierarchy of *Vruntaka Phala* is given as follows.

**Table No. 1. Taxonomical hierarchy of *Vruntaka Phala (Solanum melongena Linn.)***

| Sr. No. | Category | Description |
|---|---|---|
| 1 | Kingdom | *Plantae* |
| 2 | Subkingdom | *Viridaeplantae* |
| 3 | Infrakingdom | *Streptophyta* |
| 4 | Division | *Tracheophyta* |
| 5 | Subdivision | *Spermatophytina* |
| 6 | Infradivision | *Angiospermae* |
| 7 | Class | *Magnoliopsida* |
| 8 | Subclass | *Asteridae* |
| 9 | Order | *Solanales* |
| 10 | Family | *Solanaceae* |
| 11 | Genus | *Solanum* L. |
| 12 | Species | *Solanum melongena* Linn. |

### *1.2 Vernacular Name[24]:*

In India, *Vruntaka Phala* has various nomenclatures in different regional languages, which are as follows:

**Table No. 2. Vernacular name of *Vruntaka Phala (Solanum melongena Linn.)***

| Sr. No. | Language | Vernacular Name |
|---|---|---|
| 1 | Sanskrit | *Vruntaka, Vartaku, Bhantaki, Bhantika* |
| 2 | English | *Brinjal* |
| 3 | Hindi | *Bhanta, Baingan* |
| 4 | Marathi | *Vange, Vangi* |
| 5 | Assamese | *Bengena* |
| 6 | Bengali | *Begun* |
| 7 | Malayalam | *Kathrikka* |
| 8 | Kannada | *Badane* |
| 9 | Telugu | *Vankaya* |
| 10 | Tamil | *Kathirikkai* |
| 11 | Gujarati | *Ringana, Bengan, Bantaka* |
| 12 | Farsi | *Vandagan* |
| 13 | Arebi | *Vardjan, Vadanjan* |

### *1.3 Distribution[1]*

*Solanum melongena* is distributed in India, Pakistan, China, Bangladesh, Nepal, Srilanka, Philippines and contributes about 75% of world production; hence this becomes an important crop of subtropical and tropical regions.

### *1.4 Morphology*[25]

Solanum melongena is an annual shrub of height 60-120 cms. The stem and leaves are covered with small wool-like hairs. It has a woody stem with multiple branches, usually following a dichotomy ramification pattern. Leaves are large, single-lobulated, and alternate. Flowers are actinomorphic hermaphrodites with purple to white. Fruits are fleshy, smooth, and shiny and are found singly or in clusters. It has varied shapes like round, elliptical, oblong, cylindrical, etc., with different colors like purple, purple-black, yellowish, white, green, and mixed stripes. Fruit contains seeds that vary in amount from very few to abundant. Seeds are covered with fruit pulp. They are numerous, small, kidney-shaped, pale brown, and bitter in taste.

**Fig. 1 *Vruntaka Phala* plant**

**Fig. 2 Full-grown fruit**

**Fig. 3 Seeds**

## 2. MATERIALS AND METHODS

The analytical profile of a drug comprises physicochemical characteristics along with phytochemical assessment. Similarly, the analytical profile of Solanum melongena was prepared by assessing its physicochemical and primary phytochemical assay. It was done in a stepwise manner as follows.

### *2.1 Study Settings*

Analytical profile was done at the analytical laboratory of MGACH & RC, Salod (H), and the Central research laboratory, DMIMS (DU), Sawangi Meghe, Wardha.

### *2.2 Collection of Solanum melongena seeds*

Fresh, full-grown fruit of *Vruntaka Phala* (*Solanum melongena Linn.*) having abundant seeds were procured from the nearby farm. Fruits were washed with tap water and dried. Fruits were cut, and the pericarp was separated from seeds and fruit pulp. Seeds were again separated from pulp carefully. Seeds were shed, dried, and ground to form a fine powder. The seed powder was sieved from 100 no mesh to get fine powder with uniform particle size. Powdered seeds were subjected to various analytical experiments to get an analytical profile of *Solanum melongena* seeds.

### *2.3 Identification and authentication of drugs*

The herbarium sheet of the drug *Vruntaka Phala* was prepared for identification and pharmacognostic authentication was done by. Dr. Nitin Dongarwar, Professor and Head of Botany, Rashtra Sant Tukdoji Maharaj University, Nagpur, Maharashtra, India, with voucher specimen no. RTMNU/Botany/PGTD/10412-13/2020.

### 2.4 *Physicochemical parameters*

Physicochemical characteristics are important to define the plant material's physical and chemical properties, composition, identification, quality, purity, and stability. In addition, it affects the pharmacokinetics of the drug.[26] Basic physicochemical parameters include Organoleptic characteristics, Moisture content, Total ash value, Acid insoluble ash, Water soluble extractive, Alcohol soluble extractive, and pH value. These parameters were tested by adopting SOPs' mentioned in API guidelines.[27] Results were presented in table no. 03.

### *2.5 Phytochemical Parameters*

Phytochemicals are the pharmacologically active substances present in the plant. These phytoconstituents were assessed by qualitative chemical examination of extract of various parts of the plant. Phytochemical screening helps reveal the plant extracts' constituents and their predominance over the others and search for bioactive agents useful in newer drug synthesis [28]. Phytochemical evaluation was done by performing HPTLC of sample *Vruntaka Phala Beeja Churna performed Phytochemical evaluations.*

#### *2.5.1 HPTLC of Vruntaka Phala Beeja Churna*

HPTLC is High-Performance Thin Layer Chromatography, giving greater resolution and separation of components than normal TLC. The precise sample application, standardized, reproducible chromatogram development, and software assistance are the few superiorities of HPTLC over conventional TLC. Moreover, it shows similarities and differences between samples and references at a glance and hence can be employed for the purity check of a sample.[29] It was performed in a stepwise manner by using SOP for HPTLC.[30] HPTLC of a sample of *Vruntaka Phala Beeja Churna* showed two peaks at Rf values of 0.55 and 0.63.

#### *2.5.2 Evaluation of Primary Phytochemicals*[31,32]

The preliminary phytochemical study of *Solanum melongena* seeds was done using the following chemical tests and data presented in Table no. 4.

#### 2.5.2.1 *Tests for alkaloids*

***Dragendorff's test***

The presence of alkaloids was recorded by adding 1 ml of Dragendorff's reagent to 2 ml of sample extract, forming an orange-red precipitate.

#### *2.5.2.2 Tests for flavonoids:*

***Shinod's test***

The presence of flavonoids was tested by adding 10 drops of dilute HCL and a piece of magnesium to 1 ml of extract, resulting in deep pink color.

#### *2.5.2.3 Tests for Amino acids:*

***Ninhydrin test***

The presence of amino acids was confirmed by adding two drops of 0.2% freshly prepared ninhydrin solution to 1 ml of extract, which produced purple color.

#### *2.5.2.4 Tests for Tannins:*

***Ferric chloride test***

The presence of tannins was recorded by adding 2 ml of 5% neutral ferric chloride solution to 1 ml of extract, producing a dark blue color.

#### *2.5.2.5 Tests for Saponins*

The presence of saponins was indicated by foam formation on adding 1 drop of $Na_2CO_3$ solution to 5 ml of extract in a test tube, followed by vigorous shaking and stabilizing for 5 min.

#### *2.5.2.6 Tests for Carbohydrates*

***Benedict's test***

The presence of carbohydrates was tested by adding 8-10 drops of extract in 5 ml of Benedict's reagent and heating for five minutes, resulting in dark red precipitation.

#### *2.5.2.7 Tests for Terpenoids*

***Horizon test***

The presence of terpenoids was confirmed by adding 2 ml of trichloro-acetic acid into 1 ml of extract, forming a red precipitate.

#### *2.5.2.8 Tests for Steroids*

***Salkowski test***

The sample extract was shaken with chloroform. Then, concentrated $H_2SO_4$ was added along the walls of a test tube into it. The formation of red color indicates the presence of steroids.

#### *2.5.2.9 Tests for Glycosides*

***Keller Killiani test***

A solution of 0.5 ml of glacial acetic acid and 2-3 drops of ferric chloride were added into 2 ml of sample extract. In addition, 1 ml of concentrated $H_2SO_4$ was added along the walls of the test tube. The deep blue color at the junction of these solutions indicated the presence of cardiac glycosides.

## 3. RESULTS AND DISCUSSION

Solanum melongena is one of the fruit vegetables widely used in the diet. It is well known for its nutritional value. Though having a rich source of dietary fibers and antioxidant properties, it has very low caloric and fat contents. Hence it can be used in weight management, hyperlipidemia, blood pressure management, etc.[33] Also, owing to its antioxidant property, it can be useful in preventing cancer, heart disease, diabetes, and hyperlipidemia.[34] After a thorough literature search, it was observed that physicochemical data of *Solanum melongena* seeds was rarely available in published literature.[35,36] Hence it was the need of an hour to prepare an analytical profile of *Vruntaka Phala Beeja (Solanum melongena* seeds) comprising its physicochemical properties and primary phytochemicals. As mentioned in the methodology, physicochemical parameters were assessed, and values were tabulated. (Table no. 3)

**Table No. 3: Values of physicochemical parameters of *Vruntaka Phala Beeja Churna***

| Sr. No. | Test Parameter | Test Result |
|---|---|---|
| 1 | Color | Yellowish |
| 2 | Odour | Characteristic |
| 3 | Loss on drying at $105^0$C (Moisture Content) | 0.78% |
| 4 | Total Ash Value | 3.38% |
| 5 | Acid Insoluble Ash | 0.5% |
| 6 | Water soluble extractive | 21.97% |
| 7 | Alcohol soluble extractive | 11.64% |
| 8 | pH value | 5.67 |

Standard values for the physicochemical parameters of *Vruntaka Phala Beeja Churna* were not available in standard reference publications. Hence we attempted to compare test values with traditional values of another member from the Solanaceae family, viz. *Solanum xanthocarpum Schrad & Wendl.* mentioned in API.[37] The comparative data was interpreted as follows: Organoleptic tests were used for sensory evaluation of the sample. It is simple but possesses the most human form. It helps in the identification of the sample.[38] *Vruntaka Phala Beeja Churna* was yellowish with a characteristic odor. Moisture content in a drug sample affects freshness, quality, shelf-life, and bacterial resistance. Excess moisture content can

cause an increased rate of microbial growth and decrease its quality and shelf life.[39] Moisture content of a test sample was estimated by determination of loss on drying at 105$^0$C. The test value obtained was 0.78%, within the permissible limit, i.e., at most 12%. Ash value is useful in determining the authenticity and purity of the sample and serves as an important qualitative standard. The total ash value and acid insoluble ash within permissible limits indicate that the sample is free from added impurities and best for its drug action and effects.[40] Total ash value of a test sample was 3.38% which was found to be less than its upper limit of 9%, and the acid insoluble ash value was 0.5% which was less than the 3% allowable limit. The water soluble and alcohol soluble extractives are one of the qualitative parameters which determine the nature of phytoconstituents present in the sample and also give an idea about the nature of the solvent to be used for extraction.[41] The water-soluble extractive value of a test sample was 21.97%, while Alcohol soluble extractive was 11.64% which was higher than its minimal required values of 16% and 6%, respectively. The test values also suggest that phytochemicals from Solanum melongena seed were more readily dissolved in water than alcohol. It suggests that the aqueous extract of seeds was more effective than the alcohol extract. *Swarasa* (juice) is one of the aqueous forms mentioned in *Ayurvedic* classics for drug administration. Hence *Vruntaka Phala Beeja Swarasa* should be employed during its medicinal use for its better efficacy. pH value is a critical factor that impacts the drug's solubility, stability, biological tolerability, and pharmacokinetics. Hence it is important to have the pH of the sample within the permissible limit to get its desired effects.[42] The pH value of a test sample was 5.67, which was found within the normal range. It suggests that the test sample was suitable for its medicinal use. After doing HPTLC of *Vruntaka Phala Beeja churna* two peaks at Rf values 0.55 and 0.63 were observed. The primary phytochemicals in the test drug were evaluated per procedures described in the methodology, and the results were given as follows. (Table no. 4)

**Table No. 4: Evaluation of Primary Phytochemicals of *Vruntaka Phala Beeja Churna***

| Sr. No. | Phytochemical | Test Results |
|---|---|---|
| 1 | Alkaloids | Present |
| 2 | Flavonoids | Present |
| 3 | Amino acids | Present |
| 4 | Tannins | Present |
| 5 | Saponins | Present |
| 6 | Carbohydrates | Present |
| 7 | Terpenoids | Present |
| 8 | Steroids | Present |
| 9 | Glycosides | Present |

Regarding the role of plant phytochemicals and their activity, flavonoids, and polyphenols are responsible for their antioxidant, anti-inflammatory and anticancer activities.[43] Alkaloids are responsible for the analgesic property.[44] Amino acids are important in plant protein synthesis, growth and development, nutrition, and stress responses.[45] Tannins play an important role in a plant's anticancer, antiviral, antioxidant, antimicrobial, and anti-inflammatory action. They are also responsible for anti-diabetic, wound healing, cardio-protective and antidiarrheal activities.[46] Saponins help decrease blood lipids, blood glucose response, and carcinogenic risks.[47] Plant carbohydrates treat cardiovascular and hematological diseases and wound healing properties.[48] Terpenoids contribute to defending against biotic and abiotic stresses of plants and are also used as signal molecules for attracting pollination insects.[49] Plant steroids are responsible for anti-inflammatory action.[50] Plant glycosides help treat heart failures and arrhythmias.[51] All the above phytoconstituents were present in different parts of *the Solanum melongena* plant. As stated before, fruit is the richest source of phytoconstituents, followed by seeds. But it was observed that despite various active phytoconstituents, seeds were not screened primarily for their pharmacological activities. It might be because of its close amalgamation with fruit and fruit pulp. Hence it was suggested to screen the seeds separately to assess their pharmacological activities to explore new horizons of knowledge.

## 4. CONCLUSION

The current study presented an analytical profile of Solanum melongena seeds systematically. From this study, it was confirmed that Solanum melongena seeds are a rich source of various vital phytochemicals having good medicinal potential. Therefore, further analysis is possible to test its pharmacological potential by conducting various preclinical and clinical trials. It will provide a natural alternative for treating various disease conditions.

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## 6. AUTHOR CONTRIBUTION STATEMENT

Dr. Sonali Chalakh conceptualized this study and provided her valuable input in preparing the manuscript. Dr. Meghsham P. Anjankar designed the present study, curated the necessary data, and prepared the original draft. Dr. Gajanan Chatuphale gave his input in analyzing data. Finally, all the authors discussed the methodology and results to finalize the manuscript.

## 7. CONFLICT OF INTEREST

Conflict of interest is declared none.

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