Research Article

Optimizing Cultivation Techniques and Nutritional Profiles of Selected Brinjal Varieties in Solanaceae

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ABSTRACT

Aim: This study aimed to show that better cultivation practices for brinjal varieties improve their nutritional quality. Increased production and consumption of these nutrient-dense varieties helped to reduce nutrient deficiencies. **Introduction:** Vegetables are crucial for a balanced diet, and proper cultivation practices are essential for maintaining crops. Brinjal is one of the common vegetable crops that maintains and improves nutritional factors in our daily balanced diet. **Materials and Methods:** Three brinjal genotypes were used: Bhavani Gold and Purple Round, and Haritha. Field trials, conducted from February 2021 to 2022 in a Randomized block design, involved planting 2-3 seeds per plastic tray pit at a depth of 2-3 cm. Nutritional quality was assessed by analysing moisture content, total protein, carbohydrates, total reducing sugar, and lipid content in fresh, dried, and powdered fruits. Experiment was repeated in three times and statistically represented as mean, standard deviation, and standard error. **Results and Conclusion:** The study emphasised key factors such as soil suitability, optimal planting seasons, land preparations, selection of high-quality planting materials, effective production methods, storage practices, plant population management, irrigation management, harvesting techniques, and nutrient management to improve crop yield. Brinjal cultivation is suited to warm seasons, with sunlight crucial for seed germination, flowering, and fruiting. Haritha was the earliest flowering variety. The irrigation schedule ranged from 8 to 10 days in winter and 5 to 6 days in summer, while the fruit harvesting period spanning 60-160 days. Haritha exhibited higher levels of moisture content (91.2±0.2%), total protein (3.4±0.05 g/100 g), and total reducing sugar (3.1±0.03 g/100 g) compared to the local varieties Bhavani Gold and Purple Round.

Keywords: Brinjal, Cultivation, Climate, Nutrition, Harvest.

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INRODUCTION

Brinjal (*Solanum melongena* L.) is also commonly referred to as eggplant and is widely cultivated vegetable in India. Vegetables are fresh and edible part of herbaceous plant. It can be consumed either raw or cooked form. The part that can be eaten as radicle, stem, bud, petiole, fruit, immature flower, seeds etc., Cultivational practices encompass a range of agronomic production methods employed by cultivators to optimize both crop yield and agricultural revenue. These techniques involve managing climatic variations, ensuring soil suitability, determining optimal planting seasons, preparing land, selecting appropriate planting materials, monitoring for deficiency symptoms, and implementing effective harvesting times and procedures.[5] Vegetables are the good sources for protein, carbohydrate, fats, vitamins and minerals. Consuming a variety of vegetables that provide essential nutrients such as moisture, fiber, ash and energy can promote good health and reduce the likelihood of developing diseases such as cancer, coronary heart attack, and diabetes making them a crucial component of balanced diet.[2]

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In many developing countries, edible wild plants serve as valuable sources of nutrition offering means of supplementing the diets of the local populations.[1] Eggplant has been found to contain various essential nutrients such as dietry fiber, vitamins C and K, folate, potassium, and bioactive compounds like phenolic compounds. The presence of these nutrients and bio-active compounds in eggplant provides numerous wellness advantages like lowering the likelihood of chronic diseases like cardiovascular diseases, cancer and diabetes by displaying anti-oxidant, anti-inflammatory and anti-microbial properties.[14] The present study aimed that, better cultivational practices used for the production of brinjal varieties it leads to improves its nutritional quality. Increase in output and consumption of these nutrient dense varieties will helps to abate the nutrient deficiencies.

MATERIALS AND METHODS

Experimental site and plant materials

During the autumn-winter season of 2021-2022, an experiment was conducted in Eravipuram Village, near Valathungal in Kollam district, Kerala, at coordinates 8°51' N latitude and 76°37' E longitude. A completely randomized block design was employed to study three Brinjal genotypes. These included both local and released varieties, with the local varieties being Bhavani Gold and Purple Round, while the released variety was represented by Haritha.

Methods of cultivation

After the seeds were initially planted in plastic trays and exposed to sunlight, along with appropriate irrigation and moisture levels, the seedlings were transferred to grow bags after 30 days. These grow bags were filled with a potting mixture consisting of soil, cattle manure, bone dust, neem cake, and coir pit in a 1:2:1:1:1 ratio and then placed in the field. Subsequent irrigation and fertilizer applications were carried out manually based on the results of soil testing.

Nutritional evaluation

The ripened fruits of cultivars were collected, cleaned with distilled water to remove surface residues, and blotted with tissue paper. The fruits were chopped into small pieces before being subjected to oven drying at 55°C. The dried fruits were smashed and powdered by using motor and pestle and stored at sealed containers at room temperature for further analysis. The nutritional quality of the fruit was evaluated by studying the presence of moisture content, total protein, carbohydrates, total reducing sugar, and lipid. Fresh, dried, and powdered fruits were used for the nutritional study.

Determination of moisture content[10]

The estimated weight of the fresh specimen was measured, followed by drying in an oven at 114°C for 17 hr until complete dryness. After drying, the sample was weighed again. The moisture content was determined by:

$$\text{Moisture content (\%)} = \frac{\text{Loss in weight}}{\text{Fresh weight of the sample (g)}} \times 100$$

Estimation of total protein crude[6]

1 g of dried powder was weighed and thoroughly crushed in phosphate buffer. The homogenate was filtered using a cheese cloth. The resulting product was centrifuged at 3,000 rpm for 10 min. The supernatant has been collected and brought to a specified volume by adding buffer. 5 mL of the mentioned earlier solution was combined with 5 mL of 10% tri-chloroacetic acid. The mixture was vigorously shaken before being frozen for 15 min and then centrifuged at 10,000 rpm for 10 min. The top layer was decanted, and the pellet was collected. The pellet was dissolved in a predetermined volume of 0.1 N sodium hydroxide. To the disintegrated pellet, add 5 mL of reagent C (50 mL of reagent A). 2 g sodium carbonate was dissolved in 100 mL of 0.1N sodium hydroxide (0.1 N sodium hydroxide-0.4 g sodium hydroxide dissolved in 100 mL of distilled water or 0.2 g dissolved in 50 ml of distilled water), and 1 mL of reagent B (1.1% sodium potassium tartarate 1 g sodium potassium tartarate dissolved in 100 ml of distilled water or 0.5 g dissolved in 50 mL of distilled water and 0.25 g copper sulphate dissolved in 50 mL of distilled water) was added, and the solution was kept for 10 min. Then 0.5 mL of reagent D (1 mL folin's reagent and 1 mL of 0.1 N sodium hydroxide) was added, and the solution was kept for 30 min at room temperature in the dark. After 30 min, a blue color developed, and the absorbance was measured at 670 nm.

$$\text{Amount of protein (mg/g)} = \frac{\text{Concentration of standard} \times \text{OD of standard} \times \text{OD of sample}}{\text{volume pippetted} \times \text{total volume weight of tissue}}$$

Estimation of carbohydrate-Anthrone method[10]

1 g of dried powder was weighed and crushed with 10 mL of distilled water. The end product was filtered and centrifuged at 10,000 rpm for 10 min. The supernatant was collected and diluted to a known volume with distilled water. To analyse the sample, 0.1 mL of the

produced supernatant was taken and increased to 1 mL by adding distilled water. Then, 4 mL of the produced anthrone reagent (200 mg of anthrone dissolved in 10 mL of strong sulfuric acid) was added to the solution. The solution was placed in a boiling water bath for 10 min, and the absorbance at 630 nm was measured with a spectrophotometer. The sample's carbohydrate content was calculated.

Estimation of total reducing sugar-DNS method[1]

1 g of dried-out powder was collected and homogenized in 10 mL of distilled water. The mixture was then filtered via a cheese cloth to produce the filtrate. The filtrate was centrifuged at 10,000 rpm for 10 min to extract the supernatant. The supernatant was collected, and the volume was adjusted to the known volume by adding distilled water. 0.2 mL of the supernatant was diluted to 3 mL with distilled water. 2 mL of DNS reagent were added to the sample solution. The solution was then placed in a boiling water bath for 5-10 min. After boiling, the sample was chilled to produce an orange colour. The solution's absorbance was measured at 540 nm through a spectrophotometer.

(a)

(b)

(c)

Figure 1: (a) Bhavani Gold, (b) Purple Round, (c) Haritha.

$$\text{Amount of reducing sugar} = \frac{\text{Concentration of standard} \times \text{OD of standard} \times \text{OD of sample}}{\text{volume pipetted} \times \text{total volume} \times \text{weight of tissue}}$$

Estimation of lipid- Bligh and Dyer method[10]

Fresh tissue weighing 1 g has been homogenized in 10 mL of a chloroform-methanol (2:1) solution and filtered. The filtrate was collected and set to a separating funnel. A few drops of chloroform, 1 mL of saturated sodium chloride solution, and water were combined in the separating funnel. The solution was then shaken well and allowed to settle for 10-15 min. The lower fraction was carefully released into a pre-weighed petri-dish and vaporised in an oven at 60°C overnight. The lipid was estimated gravimetrically by weighing the petri-dish containing the extracted lipid.

$$\text{Amount of lipid} = \frac{\text{Weight of petriplate with lipid} - \text{weight of petriplate}}{\text{total weight of the tissue}} \times 100$$

Statistical analysis

Each experiment was repeated in three times. The findings are shown as mean, standard deviation and standard error.

RESULTS

Production Technology of Brinjal

Cultivational practices

The cultivational practices and management techniques for brinjal encompass ensuring the availability of suitable soil, considering climatic conditions, determining optimal planting seasons, preparing the land for planting, selecting high-quality planting materials, managing production and storage, controlling plant population, promoting shoot growth, addressing gaps in cultivation, implementing irrigation strategies, conducting harvesting, managing nutrients, and recognizing deficiency symptoms.

Climate and planting season

The influence of climatic factors on plant growth varies depending on the growth stage. These factors encompass temperature, moisture levels, daylight duration, and rainfall patterns. The study indicated that Brinjal seedlings require a minimum temperature threshold for optimal growth, while adult plants thrive within a specific temperature range. Findings from the current research indicated that fluctuations in rainy climates led to shifts in humidity levels, with prolonged heavy rainfall resulting in heightened atmospheric humidity, thereby fostering the proliferation of plant disease-

causing organisms and associated diseases. Additionally, daylight emerged as a significant determinant impacting plant growth, with variations in day length depends on the flowering and fruiting in vegetable crops. Moreover, the study underscored the indispensable role of sunlight in facilitating seed germination.

Furthermore, the quantity of sunlight influences the rate of fruit set and flowering in brinjal plants, with the Haritha variety exhibiting the earliest flowering followed by the local varieties Bhavani Gold and Purple Round. Increased sunlight exposure has been observed to decrease the incidence of plant diseases in brinjal plants. Another factor impacting plantlet growth is rainfall. The seeds were sown for the current study from February 2021 to February 2022, spanning a duration of one year.

Soil

The primary function of soil was to provide mineral nutrients and water. In the current investigation, soil samples were collected from the experimental sites before seed sowing for pH, N.P.K, and salinity analysis through soil testing. The pH levels in the experimental field were acidic in nature. The pH was measured at 5.6 in the home garden. The levels of nitrogen and potassium in the home garden were lower, with high phosphorus content. The soil type of the experimental site was sandy loam in nature with high salinity.

Land preparation and planting

In the present study, brinjal seeds were planted in plastic trays filled with potting mixture. The trays measured about 53×26 cm and contained numerous pits. The potting mixture comprised coir peat, cow dung, and soil in a 1:1:1 ratio. 2 or 3 seeds were planted in each pit, approximately 2-3 cm in depth. Seedlings were ready for transplanting within 1-2 weeks, once they had reached a height of 7-10 cm with 2-4 true leaves. The seedlings were hardened by withholding irrigation. Carefully uprooting the seedlings without injuring the roots, they were then transferred into grow bags after 30 days, which was typically done during the evening hours followed by irrigation. The soil around the seedlings was firmly pressed. Subsequently, the grow bags were transferred into the field, and plant-to-plant spacing was set at 45-60×70-100 cm. The potting mixture was filled in grow bags according to the soil test results.

Planting materials

Planting materials played a crucial role as fundamental inputs for agricultural production. In the present investigation, three types of brinjal varieties were selected, including two local varieties, Bhavani Gold and Purple Round, and one released variety, Haritha.

Production of quality planting materials

The present study reveals that, brinjal can be propagated through seeds. This method is safer because the rate of disease spreading lowers. Brinjal seeds are small to medium sized. Then seeds are growing and seedlings are separated for further growth.

Multiplication of planting materials

Multiplication of planting materials aimed to increase the number and preserve the essential characteristics of the mother plant. For the present work, seedlings were multiplied in plastic trays with potting mixture. The multiplication of plantlets depended on humidity, sunlight, irrigation practices, and the quality of the potting mixture.

Storage of material for planting

The present study demonstrated that brinjal seeds were visually inspected after being dried in the presence of sunlight and sorted by hand to remove debris. Subsequently, they were stored in plastic or glass containers. Proper sealing of containers was essential to prevent moisture absorption and reduce the seeds' storage lifespan.

Irrigation shedule

Increased water supply caused degeneration in the roots of brinjal varieties. Water supply for brinjal cultivation varied between germinated seedlings and adult plantlets. Germinated seedlings absorbed less water than adult plantlets. Young seedlings were typically watered in the early morning or evening. Irrigation was unnecessary during the rainy season. In winter, irrigation was provided at intervals of 8-10 days, while in summer, it was given every 5-6 days.

Gap filling

Unwanted plants and plantlets were plowed from the ground, a process referred to as gap filling. Gap filling could be performed throughout the cultivation period. In the present study, seeds were sown into plastic trays. Some of the early sown seeds failed to sprout, and new seedlings were transplanted into the gaps. This was typically done within two weeks after seed sowing.

Nutrient management

For brinjal growth, a mixture of N.P.K and biofertilizers was applied in the field. N.P.K in a ratio of 1:1:1 was deemed suitable for brinjal growth. After 60 days of planting, N.P.K mixture was applied at intervals of 10-14 days. Biofertilizers, including cow dung and vermicompost, were also utilized. Leaf area increased with greater use of nutrients.

Deficiency symptoms and Plant disease management

In the present study, nutrient deficiency symptoms such as yellowing of leaves, interveinal yellowing, shortened internodes, chlorosis, necrosis, and reduced leaf size were observed when plants lacked sufficient nutrients. To address this, the correct ratio of NPK mixture was added based on soil test results, reducing chlorosis, premature leaf fall, and stunted growth. Additionally, the rainy season was identified as a primary breeding ground for various pathogens, including brinjal stem borer, hadda beetle, and white fly, leading to root and fruit borer diseases, stunted growth, and premature flower drop. To mitigate disease spread, a neem-garlic paste-water solution in a 5:5:10 ratio was applied.

Plant population

Plant population is the number of plants present per unit of ground area. For the present investigation plants are arranged in 2-3 rows in a given area in fields.

Harvest

In the present study, it was found that the harvesting period varied between 60 to 160 days for different varieties of brinjal. Harvesting is typically done when the fruits reach a good size, develop a glossy surface, and exhibit desirable coloration. Assessing fruit maturity can be done by pressing the thumb on the side of the fruit; if the indentation springs back, the fruit is immature. Longer-fruited varieties require more time to ripen, and dullness of the fruit may indicate over ripeness. Harvesting is best done using a sharp knife, ensuring that portions of the calyx and stem are left behind on the plant. Harvested fruits are collected in baskets and cleaned before storage. They can be stored at normal temperatures for approximately 5-6 days.

Nutritional evaluation

Nutritional factors, including moisture content (%), total protein (g/100 g), carbohydrate (g/100 g), total sugar (g/100 g), and lipid (g/100 g), were determined using standard protocols. The released brinjal variety Haritha exhibited higher moisture content (91.2±0.2%), total protein (3.4±0.05 g/100 g), and total reducing sugar (3.1±0.03 g/100 g) compared to the local brinjal varieties Bhavani Gold (moisture content (88.9±0.2%), total protein (2.7±0.03 g/100 g), and total reducing sugar (2.8±0.05 g/100 g) and Purple Round (moisture content (87.4±0.3%), total protein (2.1±0.17 g/100 g), and total reducing sugar (2.5±0.08 g/100 g). Conversely, the lipid content was highest in Purple Round (3.7±0.06 g/100 g), followed by Bhavani Gold (1.6±0.08 g/100 g) and Haritha (0.3±0.00 g/100 g). However, no significant difference in carbohydrate content (0.1±0.00 g/100 g) was observed among the three varieties (Table 1). These findings suggested that Haritha might have been a promising choice for those seeking higher protein and reducing sugar content in their brinjal, while Purple Round might have been preferred by those seeking higher lipid content.

In the present work, lipid content was higher in Purple Round (3.7±0.06 g/100 g) followed by Bhavani Gold (1.6±0.08 g/100 g) and Haritha (0.3±0.00 g/100 g). The present work revealed that, the released brinjal variety Haritha exhibited higher levels of moisture content (91.2±0.2%), total protein (3.4±0.05 g/100 g), and total reducing sugar (3.1±0.03 g/100 g) than local Brinjal varieties Bhavani Gold and Purple Round.

DISCUSSION

Brinjal is an important vegetable crop belongs to the family solanaceae. The present investigation recommended that, the cultivational practices of three varieties of brinjal which includes local and released genotypes. Mishael *et al.,* 2019 suggested that, brinjal cultivation in different seasons provide farmers with an opportunity to earn more income based on cultivational techniques.[8] The quality of planting materials requires quality nursery management (Trivedi, 2015).[19]

Brinjal was considered as perennial crop with high yield, and preference was given to well-drained and fertile soil was preferred for cultivation. Sankaran *et al.,* 2006 reported that, drained loamy or clay loamy soil and pH

Table 1: Nutrient composition of three brinjal cultivar.

Sl. No.	Varieties	Nutritional Factors				
		Moisture Content (%)	Total Protein (Crude) g/100 g	Carbohydrate g/100 g	Total reducing sugar g/100 g	Lipid g/100 g
1	Bhavani Gold	88.9±0.2	2.7±0.03	0.1±0.00	2.8±0.05	1.6±0.08
2	Purple Round	87.4±0.3	2.1±0.17	0.1±0.01	2.5±0.08	3.7±0.06
3	Haritha	91.2±0.2	3.4±0.05	0.1±0.00	3.1±0.03	0.3±0.00

(Mean±Standard Error).

of 5.5-6 is suitable for brinjal cultivation.[15] Compared with the present investigation the pH of experimental soil is acidic in nature. Another important factor for brinjal cultivation is to maintain optimum temperature. It depends on seedling growth, fruit set etc. the previous studies revealed that, brinjal is a warm season crop, optimum temperature required for brinjal cultivation is about 21-33ºC (Masanam, 2022).[7]

Singh *et al.,* 2012 evaluated that the multiplication of plants involved factors such as plant species, variety, propagation method, climatic and growth conditions, etc.[16] Irrigation played a crucial role in flower and fruit set formation in brinjal. Lack of watering during these seasons led to blossom end rot and malformed fruit (Ebert, 2011).[4] For the better yield of eggplants, provide nutrient applications. In the current study recommended for the growth of seedlings to use a mixture of coir peat, cow dung and soil in a 1:1:1 ratio. Sundararasu and Jeyasankar (2014) evaluated the effect of vermiwash. The experiments proved that, the application of vermiwash enhanced the growth parameters like plant height, number of leaves, number of flowers and fruits per plant.[18]

Plant nutrients were essential and the most critical inputs for producing sufficient and healthy food for the expanding world population. The depletion in soil nutrients led to a loss of productivity (Bijay and Yadvinder).[3] Brinjal fruits show high nutritional and medicinal impacts it includes high fiber content, low calorie count, and high levels of vitamins and minerals such as vitamin C, potassium and magnesium (Patil *et al.,* 2012).[11]

Previous studies to check the protein content in seven different varieties of brinjal ranged from 1.24% to 2.34%. The highest protein content was observed in the variety Arka Keshav (2.34%), while the lowest protein content was found in the variety Arka Neelkanth (1.24%) (Raju and Naidu,2015).[12] In the present work, the released brinjal variety Haritha exhibited higher moisture content (91.2±0.2%), total protein (3.4±0.05 g/100 g), and total reducing sugar (3.1±0.03 g/100 g) compared to the local brinjal varieties Bhavani Gold (moisture content (88.9±0.2%), total protein (2.7±0.03 g/100 g), and total reducing sugar (2.8±0.05 g/100 g) and Purple Round (moisture content (87.4±0.3%), total protein (2.1±0.17 g/100 g), and total reducing sugar (2.5±0.08 g/100 g). The moisture content of brinjal reduced after room temperature storage, with mature fruits losing more moisture than young ones (Mote *et al.,* 2014).[9]

Studies involve the nutritional composition of six different varieties of brinjal in India. They all contained high amounts of dietary fiber, potassium and vitamin C. This study also reported that brinjal was low in fat and calories, making it a good food for those trying to maintain a healthy weight (Singh and Bhandari, 2014).[17] The previous work documented that the protein content in six different brinjal varieties using biuret method. The protein content in these varieties ranged from 1.30% to 2.12%, with the highest protein content observed in the variety Pusa Kranti (2.12%) and the lowest in the variety Pusa Uttam (1.30%). Compared to the present work Haritha shows highest protein content (3.4±0.05 g/100 g) (Yadav and Singh, 2017).[20]

Ramakrishnan *et al.,* 2012 documented the impact of processing on the lipid content and fatty acid composition of brinjal. They found that frying brinjal slices resulted in a significant increase in the lipid content and a decrease in the unsaturated fatty acid content. The processing method of brinjal depends on its nutritional quality.[13]

CONCLUSION

This study demonstrated that improved growing procedures for brinjal types substantially improve their nutritional value. Enhanced production and consumption of these nutrient-dense forms can assist to address nutritional shortages. Profitable vegetable farming based on some cultural practices it includes area distribution and production, soil, climate, planting seasons, land preparation and planting, planting materials, irrigation, nutrient management, harvesting etc. Brinjal propagated through seeds. Planting material is stored in plastic or glass containers. Nutrient management is essential for plant growth other ways lead to deficiency symptoms. NPK is the major nutrient for the production of good-quality vegetable crops. Brinjal cultivation thrives during warm seasons, as sunlight is required for seed germination, flowering, and fruiting. Haritha was the earliest flowering variety studied, indicating the potential for increased nutritional yield and agricultural efficiency. The findings of this study can also contribute to the overall goal of achieving sustainable agricultural practices and ensuring food security for the growing population.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

N.P.K: Sodium, Phosphorus, Potassium; **pH:** Potential of Hydrogen; **°C:** Degree Celsius; **%:** Percentage.

SUMMARY

The study investigated the impact of improved cultivation practices on the nutritional quality of three brinjal varieties: Bhavani Gold, Purple Round, and Haritha. Conducted over a year in a randomized block design, the research focused on factors like soil suitability, planting techniques, and nutrient management. Haritha showed early flowering and higher nutritional content, including moisture (91.2±0.2%), total protein (3.4±0.05 g/100 g), and total reducing sugar (3.1±0.03 g/100 g) compared to local varieties. The findings underscored the potential of optimizing agricultural practices to enhance the nutritional value of brinjal, promoting its role in addressing nutrient deficiencies through increased consumption.

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