

Ethnobotanical importance of brinjal in India

Brinjal is an important vegetable crop which has been known for its culinary and therapeutic uses since ancient times. The cultivar differences concern mainly the peel colour, shape, size and weight of comestible fruits, but the chemical composition, earliness of fruiting, and environmental-posed challenges also play a significant role in genesis of variability and acquisition of different morphological forms. Variation in morphology and biochemical content in brinjal fruits is an important factor that governs the choice of fruit for human consumption or liking for a specific type. The genetic differences among the genotypes are potentially relevant to breeding programs in that the variability created through hybridization of the contrasting forms could be exploited. Although it is a popular vegetable in India, the various plant parts are also used as medicines for treatment of inflammations, cardiac disabilities, bronchitis, asthma and several forms of neuralgias.

Brief history of brinjal

Brinjal (*Solanum melongena* L.) is grown worldwide for its edible fruit. Most commonly seen form is purple one which is the spongy absorbent fruit used in several cuisines. Brinjal and their progenitor species are believed to be originated in India but its cultivation in China began in 5th century B.C, which is now reported to be the secondary center of origin and domestication of brinjal. Therefore, brinjal is referred to be a vegetable of 'Indo-Chinese' center of origin. Brinjal is usually used as vegetable but the ancient history also describes the therapeutic uses of brinjal, which is usually a warm-weather crop but the related species are dispersed in different climatic zones from arid and semi-arid zone to desserts with extremely high temperature.

Taxonomical hierarchy

Solanum represents one of the most hypergenus group among the angiosperms comprising nearly 1,500 species. Many *Solanum* species are widely used as vegetables and also as popular medicines due to presence of steroidal alkaloids and phytochemicals of human benefit. Species level taxonomy of *Solanum* is always challenging due to presence of large number of species distributed around almost all the parts of the world in an array of habitats. The genus *Solanum* is sub-divided into 13 major clades, the largest of which is the *Leptostemonum* clade comprising nearly 450 species. Brinjal exists in three common cultivated forms, *S. melongena* (brinjal brinjal), *S. aethiopicum* (scarlet brinjal), and *S. macrocarpon* (gboma brinjal) which are native to Asian, African and Europe countries, respectively. They are well-suited for phenotyping and agronomical studies as they exist in several morphological forms. The European Brinjal

Genetic Resources Network and the International Board for Plant Genetic Resources have developed various morphological descriptors to characterize brinjal for use in breeding programs.

Distribution of brinjal and species diversity

Brinjal is an important crop of subtropics and tropics and grown extensively in India, Bangladesh, Pakistan, China and Philippines. It is believed to be originally domesticated from the wild nightshade species *S. incanum* also known as bitter apple, with two independent domestications centers, one in South Asia and another one in East Asia. Crop Wild relatives (CWR) of brinjal are good choice for interests in breeding as they render an extremely valuable gene pool to draw useful alleles required in breeding programs. Some wild forms used in breeding and related to common brinjal includes *S. insanum*, *S. incanum*, *S. macrocarpon*, *S. aethiopicum*, *S. torvum*, *S. khasianum*, *S. sisymbirifolium*, *S. indicum*, *S. nigrum*, *S. xanthocarpum* and *S. gilo*.

Cultivated brinjal exists in three most common forms, *S. melongana* var. *esculentum* which is the common aubergine including many cultivars; *S. melongena* var. *depressum* which is dwarf aubergine; and *S. melongena* var. *serpentium* which are the snake aubergines. Many other forms/types of brinjal like *agreste*, *album*, *divaricatum*, *esculentum*, *giganteum*, *globosi*, *inermis*, *insanum*, *leucum*, *luteum*, *multifidum*, *oblongo-cylindricum*, *ovigera*, *racemiflorum*, *racemosum*, *ruber*, *rumphii*, *sinuatorepandum*, *stenoleucum*, *subrepandum*, *tongdongense*, *variegatum*, *violaceum*, and *viride* are also known which are considered as different cultivar groups of brinjal. Even with availability of such large germplasm of cultivated type and related wild species of brinjal, the research in brinjal has not gone mostly beyond the yield



Wild species of *Solanum* maintained at ICAR-IIVR, Varanasi

attributes and developing varieties for biotic and abiotic stress.

A major break-through in brinjal improvement has been mediated through genetic engineering; the *Bt*-brinjal developed by inserting the *cry1Ac*-gene from *Bacillus thuringiensis*. *Bt*-brinjal was developed with a view to have complete control over brinjal fruit and shoot borer (BFSB) without affecting non-target arthropod biodiversity, reduced insecticide sprays and up to six fold increase in the farmer's profit. In view of nutritional security and toxicity-assessment upon human health and strict monitoring of the regulatory mechanism for such GM crops in the country, the technology is under moratorium from the Parliamentary Committee on Agriculture since 2012.

Nutritional value and phyto-chemistry of brinjal

Every hundred grams of a raw brinjal fruit comprises 92% water, 6% carbohydrates, 1% protein, and has negligible fat. Minor changes in nutrient composition may occur with changes in climate or environment of cultivation and genotype. Although it provides low amounts of essential nutrients with only manganese having a moderate percentage (11%) of the daily value, fruits are rich source of dietary fibres, vitamin B1, B3, B6, C, K, pantothenic acid, beta-carotene equivalents and folate. Fruits also contain arginine, aspartic acid, histidine, delphinidine—3 bioside (nasunin), oxalic acid, solasodine, ascorbic acid, tryptophan, *etc.* Leaves contain rich amounts of chlorogenic, hydrocaffeic and protocatechuric acids. Some of the alkaloids present are tropane, pyrrolidine, quinazolinidine, steroid alkaloids and glycoalkaloids. Two namely steroidal saponins melongoside-L and melongoside-M, and three new saponins melongoside-N, -O and P, have been isolated from Brinjal seeds.

Catechol oxidase has been isolated and characterized from *S. melongena*. Another bioflavonoid glycoside, *solano*flavone present in the leaves and fruits of *S. melongena* has also been isolated.

Medicinal and culinary uses of brinjal

The medicinal properties of the plant are derived from its chemical constituents. The plant's antioxidant property is due to the presence of flavonoids. The presence of terpenes makes it useful for bronchitis and as an analgesic because of the alkaloids. Besides these, brinjal is also known to possess anti-pyretic, antioxidant, anti-asthmatic and spasmogenic activities,

and hypotensive, anaphylactic and hypo-lipidemic actions. Besides these, the biological activities of alkaloids such as *calystegines* and *nortropane* isolated from brinjal have also been described in regulating normal heart functioning. Fruits of brinjal contains high amount of dietary fibre which benefits to manage blood cholesterol levels. Chlorogenic acid which is a primary antioxidant in brinjal is known to decrease the levels of low density lipoprotein (LDL) or bad cholesterol and reduces the risk of fatty liver diseases. The polyphenols present in brinjal helps protect the body from severe forms of cancer. Anthocyanins and chlorogenic acid are also known to protect tissues from damage caused by free radicals. In the long term, this may help prevent tumor growth and the spread of cancer cells. Anthocyanins also helps achieve this by preventing new blood vessels from forming tumor, reducing inflammation, and blocking the enzymes that help cancer cells spread. Other research on animal studies has suggested that nasunin, an anthocyanin in brinjal skin helps protect the brain cell membranes from damage caused by free radicals. Nasunin also helps transport nutrients into cells and move waste out.

In India, generally the choice of people for the type of brinjal changes in every 250-300 km providing a wide range of market segment for the vegetable crop. This high variation in choice for brinjal could not be attributed just to the existing morphological variation, but also provides scope for nutrient profiling of diverse germplasm of the crop collected and being conserved at various government institutes/organizations.

For further interaction, please write to:

Drs Shailesh Kumar Tiwari, Pallavi Mishra and Krishna Kumar Rai, ICAR-Indian Institute of Vegetable Research, Varanasi 221 305.
Email: tiwarishailu@gmail.com