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Nutritional Content and Health Benefits of Eggplant[#]

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ABSTRACT

Vegetables supply various minerals, vitamins, dietary fibers along with important phytochemicals that plays a major contribution in our balance diets and nutrition. Each vegetable contain a unique amount of various nutrients that are strongly linked with the protection of different health diseases. Eggplant (*Solanum melongena* L.*) is* a nonwoody annual plant with purple to white flowers along with enlarged lobed leaves with bushy foliage that grows with maximum height of 120cm. Eggplant is mainly grown for vegetables and medicinal purposes. The phytochemical analysis of eggplant shows that it is the rich source of various essential compounds aspartic acid, tropane, flavonoids, lanosterol, gramisterol, steroid alkaloids, glycoalkaloids, histidine, nasunin, oxalic acid, solasodine, ascorbic acid and tryptophan that are present in fruits and leaves. It also contains low calories and high moisture contents. These compounds were found helpful in the cure of various diseases like cancer, anti-inflammatory, anti-asthmatic, anti-platelet hypo-lipidemic, and hypotensive etc. Today most modern scientific techniques are available to cure different various health problems but still majority of population across the globe depends upon the traditional herbal medicines and practices. This review mainly explains nutritional content, medicinal and health benefits of *S. melongena*

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Introduction

A wide range of secondary metabolites along with primary metabolites is producing by plants that influence human nutrition and health as well (Korkmaz et al., 2018). Primary metabolites are proteins, vitamins, lipids and carbohydrates, etc. which mainly involved in developmental and physiological developments of plants that are also vital in our diet (Sevindik et al., 2018)Secondary metabolites are those phytochemicals often play a crucial role against different stresses but are not important for basic processes of the plant (Sevindik et al., 2017) Moreover, these phytochemicals are a vital basis for various medicines and pharmaceutical industry, even recent modern and traditional remedies mainly depend on these phytochemicals (Sevindik, 2019). Vegetables are excellent sources of such compounds that constitute the main portion of our diet and consider as a major source of vitamins (A, B complex (B1, B6, B9) and E), dietary fibre, minerals, and phytochemicals (Quebedeaux Eisa, 1990, Wargovich, 2000). Intake of vegetables in our daily diet results with over-all good health impact, reduction in gastrointestinal problems, improvement in vision and also playing an important role to reduce danger for various systems of cardiovascular problems, cancer, diabetes, stroke, anemia, gastric ulcer and other long-lasting disorders (Hyson, 2002, Golberg, 2003). Lower risk of cardio-vascular diseases in humans strongly associated with high intake of vegetable diet (Mullie and Clarys, 2011). According to the World Health Report, each year 2.7 million death causes because of a diet poor in vegetable consumption and with stumpy intake of dietary fiber, carbohydrates and proteins (Dias, 2011). A survey carried out regarding world vegetable cultivation showed that around 402 vegetables are cultivated across the globe, characterize 69 families and 230 genera (Kays, 2011). Leafy vegetables (both leaves or fresh leaves) are utilizde were the most frequently consumed (53% of the total), trailed by vegetable with below ground edible portions covered 17% and then by vegetable fruits (15%) (Kays and Dias,1995, Kays, 2011).

Eggplant (*S. melongena*) usually known as brinjal in south Asia (especially Pakistan, India, and Bangladesh), aubergine in Europe, melongene in West Indies, Guinea squash in America and patlican in Turkey. It belongs to a family *Solanacea* with a bushy foliage with an average height of about 60 to 95 cm. Eggplant is a warm season plant. Fruit from eggplant is available in the market throughout the year as it is generally grown twice or thrice in a year. The fruit is very nutritious and uses for medicinal purpose. Eggplant is shown a variety of shapes (egg to long club shaped) and colors occurs from white, green, yellowish, through grades of purple pigment to almost black color (Sihachkr et al., 1993). Eggplant has very low calories in its fruit with a good mineral content that is helpful for our health. Eggplant is ranked amongst the most top ten vegetables that provide the healthiest food with low calories and also contain high phenolic contents that are helpful in radical absorbing capacity (Cao et al., 1996, Caguiat and Hautea, 2014). Eggplant is a host of various vitamins, minerals, iron, calcium, potassium, magnesium, and phytochemicals that contain phenolic components (caffeine and chlorogenic acid), flavonoids, mainly nasunin. Nasrin or delphinidin- 3-(coumaroyl-rutinoside)-5-glucoside is key phytochemical in brinjal that is widely present in peel of eggplant (Matsuzoe et al., 1999).

Eggplant is basically originated from South Asia (Pakistan and India) in the 3rd century and during the 4th century in China, then in 9th century in Africa (Bhaskar and Ramesh Kumar, 2015, Sekara et al., 2007). Although, it was initially broadly grown in China (Bhasker and Ramesh Kumar 2015, Chong, 2005). The eggplant was named initially by Thomas Jefferson (an experimental botanist) who familiarized eggplant in the United States in 1706 (Jett 2011, Noda et al., 2000).

Nutrients Present in Eggplant

Eggplants are a rich source of abundant nutrients and their contents (mentioned in Table 1) which all desirable mainly for body growth, to overhaul of worn out materials and also provide shield. Eggplant are the complete set of minerals, vitamins, nutritional fiber, protein, anti-oxidants, along with some phyto-chemicals that having scavenging activities (Noda et al., 2000, Whitaker and Stommel. 2003). Major phytochemicals in brinjal, caffeic, chlorogenic (phenolic components) glucoside, delphinidin and nasunin (flavonoids) (Bhasker and Ramesh Kumar, 2015, Cassidy et al., 2013, Choudhury, 1976, Kwon et al., 2004, Matsubara et al., 2005).

Table 1 Nutrients and their contents in eggplant.

Components		Percentage of RDA			
		Minerals	mg	Vitamins	mg
Energy	(1%) 100 - 104 kJ	Ca	7.4 -9.0 mg (1%)	Vit. A	0.8 mg (1%)
Carbohydrates	(4%) 4.70- 5.88 g	Fe	0.20-0.24mg (2%)	Vit. B complex	18 - 22 mg (3 – 6 %)
Sugars	2.35-3.53 g	Mg	13.5 - 14 mg (4%)	Ascorbic Acid	1.8 - 2.2 mg (3%)
Dietary fiber	(9%) 2.80-3.40g	Mn	0.20-0.25mg(11%)	Vit. E	0.2 - 0.3 mg (2%)
Fat	0.18-0.20g	P	22.5 - 25 mg (3%)	Vitamin K	2.9 -3.5 mg (3%)
Proteins	(2%) 0.80 - 1.01 g	K	129 - 130 mg (5%)		
		Zn	0.10-0.16 mg (2%)		

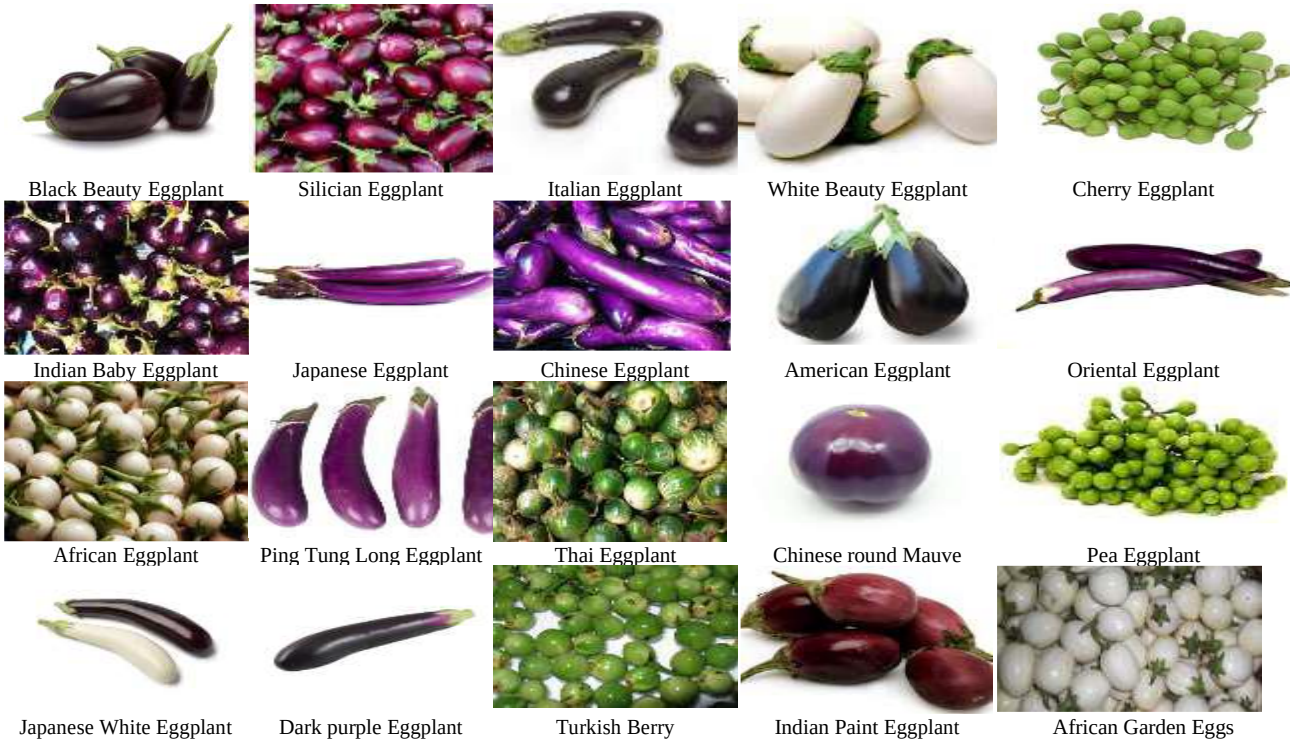

Figure 1 20 most common eggplant types (Bhasker and Ramesh Kumar, 2015, Nyadanu et al., 2014, 2015, Hirst, 2014, Sekara et al., 2007).

Types of Eggplant

Numerous collections and various names were given to eggplant originate from different countries, on the basis of different colors and shapes. According to Sekara et al., 2007 there are 33 different Sanskrit terms for brinjal in antique Indian literatures, while Hirst, during 2014 recently confirms that eggplants have almost 20 most common varieties (Figure 1).

Health Benefits of Eggplant

Except for the nutritional and agricultural importance of eggplant, it has also numerous quantities of therapeutic benefits (Table 2). Various research shows that the eggplant extracts have superb healing effects on different disorders like burns, warts, inflammatory infections, gastritis, stomatitis and arthritis (Im et al., 2016). Eggplant is producing a widespread choice of various secondary metabolites along with some other compounds such as glycol-alkaloids, antioxidant compounds, and vitamins which carried a significant part in keeping good health. For example, a major phenolic compound chlorogenic acid (5-O-caffeoyl-quinic acid; CGA), found in fruit skin (Prohens et al., 2013) which work as an anti-obesity, anti-inflammatory, anti-diabetic agent and also have cardio-protective functions (Plazas et al., 2013). A research conducted by Afshari et al., (2016) proved that extracts from brinjal have a extra toxic result on cancer cells than on normal cells. Chlorogenic acid also shows anticarcinogenic functions by making apoptosis in many human cancer cells, such as leukemia and lung cancer cells (Tajik et al., 2017). Eggplant also shown an effective action against various bacteria like *Escherichia coli, Staphylococcus aureus, Bacillus subtilis, Vibrio cholerae, Pseudomonas sp. and B. cereus* (Ahmed et al., 2016).

Eggplants are the rich source of anthocyanin compounds, besides their coloring functions. It has been known that anthocyanin has significant role against diabetes, neuronal problems, cardiovascular disorders, and cancer as well. Purple eggplant has a high amount of nasunin compound in their flesh that consumption of such purple eggplant helps against lipid peroxidation and ROS accumulation which occur due to a high level of iron in cells (Casati et al., 2016). Anthocyanins present in the skin of eggplant rise serum antioxidant volume and support against heart illness and hyperlipidemia by decreasing LDL (low-density lipoprotein) oxidation. Anthocyanin in peels of brinjal seems vital part in stopping overweightness by plummeting serum triglyceride and cholesterol and increasing high-density lipoprotein (HDL) cholesterol and decreasing serum triglyceride level (Seeram et al., 2001). Moreover, they are also helpful in ulcer treatment and vision (Yousuf et al., 2016, Ghosh and Konishi, 2007).

As carotenoids cannot be synthesized by our body, they should be taken in our diet. Carotenoid-rich foods consumptions strongly related through reducing the hazard of some types of cancer (Linnewiel-Hermoni et al., 2015). Vitamin A deficiency is one of the major problems for school-age children mostly in developing countries. Carotenoid-rich eggplant diet can reduce this problem in such countries (Kamga et al., 2013).

Glycoalkaloids present in eggplant own anti-cancer actions. Naturally happening aglycone compound (solasodine) decreases human lung cancer cells *in vitro* (Shen et al., 2017). They also have anti-inflammatory functions and also beneficial to lower blood cholesterol (Friedman, 2006).

Fiber contents present in eggplant helps in digestion by removing toxins and harmful materials from our stomach thus by reducing stomach and colon cancer (Fraikue, 2016). In addition, the phytonutrients present in eggplant protect cell membranes and boost the memory function of the brain. It maintains brain health via protecting its cell contrary to the obliteration of free radical cells. Compounds present in the eggplant have also the ability to avoid the brain tumor.

Eggplants are a rich source of magnesium, manganese, potassium, and copper that are important for health bones. Eggplant is also known an Fe chelator that is suggested particularly for pregnant females, lactating mothers and teenagers females specifically. The Fe in eggplant has the ability to pact with pre-menstrual syndrome, amenorrhea, and antenatal anemia. (Bhasker and Ramesh Kumar, 2015, Cassidy et al., 2013, Chong, 2005, Krisban, 2013).

The fruits are important in the treatment of various disorders like asthma, dysuria, dysentery, high blood pressure, and also to cure osteoporosis, arthritis, diabetes and bronchitis, heart diseases and strokes (Sekara et al., 2007., Seneff et al., 2011). Moreover, the matured fruits of eggplant are employed against stomach troubles, compress for swellings and splintered nipples (Murray, 2004, Small, 2009). Juice extracted from roots and leaves of brinjal are used to cure skin diseases, cough, otitis, anorexia, tooth ache, burns, general stimulant, piles, inflammation, intestinal foot pain, throat and stomach difficulties (Mak, 2013, Murray, 2004, Sekara et al., 2007). Researcher pointed out that patients with Fe deficiency in their body must include eggplant, especially Turkey berry, Thai eggplant and cherry eggplant for good results (Asiedu-Addo, 2014, Putra, 2011,). It is also found out that dry eggplants are beneficial in the treatment of stomach bloating, gas and treat piles, while the fresh fruits consumption strength bones, control diabetes, prevent paralysis and helpful in teeth related problems (Cassidy et al., 2013, Krisban, 2013).

Some varieties of eggplant like Chinese round and purple dark shades eggplants are employed for ornamental and beautification purpose. It is also considered as a love symbol in many parts of India, similarly, in the USA it was explained as apples of love. The high culture females of China use the shady species of brinjal for cosmetic purpose as a fashion and to color their teeth (Lawless, 2010, Sekara et al., 2007, Bhasker and Ramesh Kumar, 2015).

Conclusion

Eggplant is a agronomically and economically important plant member of *Solanaceae* family with a significant foundation source of various vital pharmaceuticals and nutraceuticals compounds. A restricted sum of research were performed to explored health maintain compounds present in eggplant besides antioxidant and phenolic activities. Additionally, primary metabolites, like amino acids and carbohydrates, mainly overlooked. Needless to say, eggplant are rich source of various valuable bioactive components which must be recognized and more research would be carried out to recognize the nutritive and pharmacological worth of eggplant in real words.

Table 2 Explanation of human health-related characteristics of eggplant (Modified from Meyer et al., 2014).

Human Body System	Positive	Negative	Neutral
Nervous System	Weight loss, heat loss, prevents breakdown of Narcotics, reduces pain, cure migraine, protects memory, tranquilizer, insomnia treatment, eating reduces fever	Makes you short of breath, induces headache	Weight gain, heat gain, Compress reduces fever
Cardiovascular System	Anti-cholesterol, heart Attack protection, reduces blood pressure, Atherosclerosis, stops bleeding, treats Enlarged spleen, improves circulation,		Relieves hemorrhoids
Gastrointestinal System	Reduces liver problems, calcium source, fibre source, increase appetite, good for digestion, meat Replacement, easy to digest	Heavy to digest, removes food stagnation,	
Urinary System	Reduces blood pressure, Diuretic, cleans kidneys	Avoid if you have kidney stones	
Reproductive System	Miscarriage recovery-uterus stabilization, good for fetus development, good nutrition for lactating mothers,	Ingestion can abort a fetus; avoid if menstruating	Affects fertility
Heal	Heals wounds/cuts, compress heals burn, compress Cooked, compress raw, heals broken bones		Reduces swelling, replaces bandage, reduces Infection
Cancer	Skin cancer and Gastrointestinal cancers treatment,		General anticarcinogenic
Respiratory System	Cures respiratory problems, Cures throat problems and cough, reduces Phlegm,	Makes you short of breath	Increases phlegm
Integumentary System	Freckle reduction, age spot Reduction, skin wash, improves cell elasticity, Treats skin rashes and irritation	Avoid if skin is sensitive, avoid because it can cause an allergic reaction	Replaces bandage. Reduces swelling,
Skeletomuscular System	Heal broken bones	Avoid arthritis	
Metabolism	Weight loss, heat loss, anti-diabetes, anti-cholesterol, high nutrients, Atherosclerosis, meat replacement		

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