

Nutritional and Medicinal Properties of Solanaceous Vegetables

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Introduction

The family **Solanaceae**, or **nightshades**, is an economically important family of flowering plants. The family ranges from annual and perennial herbs to vines, or either shrubs, and trees, including a number of important vegetable crops like tomato, pepper, eggplant, white and red potato, and tomatillo. This family also contains several plants that are considered toxic to humans being such as the weeds jimsonweed, nightshade and mandrake. Many members of the family contain potent alkaloids that are having immense value by considering its nutritional value. The family belongs to the order Solanales, in the asterid group dicotyledons (Magnoliopsida). The solanaceae consists of approximately 98 genera and about 2,700 species, with a great diversity in their habitats, morphology and ecology.

Worldwide 53% of children are malnourished and underweight with 40% of them living in India. Solanaceous vegetable crops are important source of vitamin C, A, E, thiamine, niacin, pyridoxine, folacin, minerals and dietary fibres which play a significant role in human nutrition and helps to cope with malnutrition.

Nutritional and Medicinal Properties of Tomato

Tomatoes are the 2nd highly produced and consumed vegetable in the world today. Tomato is consumed either fresh or in many processed forms like ketchup, canned whole or in pieces, puree, sauce, soup, juice, or sun-dried. Tomato fruits are considered a low energy dense food with unique constituents that may positively affect health. The tomato fruit has a unique nutritional and phytochemical profile. The major phytochemicals are the carotenoids that consists of 60% to 64% lycopene, 10% to 12% phytoene, 7% to 9% neurosporene, and 10% to 15% carotenes. Tomato is highest source of lycopene (71.6%) among vegetable crops, second as a source of vitamin C (12.0%), pro-vitamin A, carotenoides (14.6%) and other carotenoides (17.2%) and third as a source of Vitamin E (6.0%). Structurally, lycopene is a tetraterpene and assembled from eight isoprene units that are composed of carbon and hydrogen. It is insoluble in water. Lycopene's eleven conjugated double bonds give its deep red color and

its antioxidant activity. Other carotenoid in tomato constitute β -carotene and small amount of phytoene, phytofluene, α -carotene, γ -carotene, neurosporene, and lutein. Its fruits contain small but significant amounts (1 - 2 mg/kg) of lutein, α -, β -, and γ - tocopherols, and conjugated flavonoids. Total flavonoids content ranged from 1.3 to 22.2 mg/kg with about 98% present in the skin. Flavonoids in fresh tomato are present only in the conjugated form as quercetin and kaempferol. Among all different types of cultivated tomato cherry tomatoes have higher flavonoids content than standard or beef tomato cultivars and field grown fruits have higher flavonoids content than greenhouse- grown. Vitamin C content in tomato is moderate (84 to 590 mg/kg) but its contribution to diet is significant because of its high consumption. Tomato are also a good source of potassium, foliate, and vitamin E, soluble and insoluble dietary fibers like pectins, hemicelluloses and celluloses, with a concentration ranging from 0.8 to 1.3 g/100 g fresh wt. Tomato consumption with their distinctive nutritional attributes may play an important role in reducing the risk of cardiovascular and associated diseases through their bio activity in modulating disease process pathways. Consuming diets with appreciable amounts of antioxidants from tomatoes, to inhibit the oxidative process of low density lipoprotein may be one way to reduce the risk of cardiovascular atherosclerotic disease. Tomato intake about 40 g tomato paste that corresponds to a lycopene dose of approximately 16 mg for more than 8 weeks reduced ultraviolet light induced erythema and protects skin from UV damage. These protective effects may be due to the ability of lycopene and other antioxidant components to prevent cell damage through synergistic interactions.

Nutritional and Medicinal Properties of Brinjal

The eggplant, known as aubergine in Europe, brinjal in south Asia and Baigan in hindi. There is great diversity of brinjal in India based on shape, size, colour as well as preference for consumption. India is considered as center of origin of brinjal. Phytochemicals contained in brinjal include phenolic compounds like caffeic and chlorogenic acid, and flavonoids, such as nasunin. Nasunin or delphinidin- 3-(coumaroylrutinoside)-5-glucoside is the major phytochemical in brinjal. Nasunin is part of the anthocyanin purple pigment found in the peel of eggplant. Nasunin represents between 70% to 90% of the total anthocyanins in the peel. The predominant phenolic compound found in brinjal fruit is chlorogenic acid, which considered one of the most potent free radical scavengers found in tissues. Chlorogenic acid acts as antimutagenic (anti-cancer), antimicrobial, anti-low density lipoproteins i.e. bad cholesterol and

antiviral activities. Brinjal is an excellent source of digestion supportive dietary fiber and bone building manganese. Brinjal come with a good amount of minerals (0.3g). It is very good source of enzyme-catalyzing molybdenum and heart healthy potassium. Eggplant is also a good source of bone building vitamin K and magnesium as well as heart healthy copper and some vitamins such as vitamin B (63.5 %), vitamin C (3%), and vitamin K (3.5 %) which give nourishment to your scalp and keep it healthy. Hence it keeps scalp-related problem at bay. The brinjal has good amount of vitamin C which make it is an effective anti-viral and anti-bacterial source. Brinjal has a cooling effect on eyes, neutralize acidity and removes calcium. The water contents of egg-plant nourish hair roots. This in turn helps keep your hair stronger. The skin of egg plant have a lot of anthocyanins. These antioxidants act as anti-ageing agents. In particular antioxidant found in egg-plant helps prevent skin cancer. White brinjal are highly beneficial for regulation of blood sugar levels in human body and also controls absorption of glucose. This makes them the best option for people suffering from diabetes. Egg plant is considered to be high in water content yet low in calorie count. Egg-plant contain phytonutrients which keep the cell membranes protected of any damage and facilitates the message transfer from one part to another, thus preserving the memory function.

Nutritional and Medicinal Properties of Capsicum

Peppers produced in beautiful array of colors and shapes. It is considered one of the most important spices in Indian dishes. India is major producer, consumer as well exporter of hot pepper in the world. Peppers add flavor, color, and crunch to many low-calorie dishes. Fresh peppers are considered excellent sources of vitamins C, K, carotenoids and flavonoids. The major phytochemicals present in hot peppers are capsaicinoids. More than 20 capsaicinoids have been identified that belongs to two groups, capsaicin and dihydrocapsaicin. Capsaicin was discovered in 1846 and its structure, as an acid amide, was elucidated by Nelson. Capsaicin constitutes about 70% of the pungent flavour in hot pepper, while dihydrocapsaicin contribute 30%. The chief constituent of chilli fruit pericarp is a crystalline colourless pungent principle known as capsaicin or capsiutin ($C_{18}H_{27}NO_3$), a condensation product of 3- hydroxyl – 4 methoxy benzylamine and decylenic acid which produce a highly irritating vapour on heating. It is secreted by the outer wall of fruits. Significant variations in the profile of capsaicinoids are found between and within pepper species that range from about 220 ppm (3400 Scoville Heat Units, SHU) in *Capsicum annuum* to 20,000 ppm (320,000 SHU) in *Capsicum chinense*. Green

chillies are rich source of vitamin A & C and the seed contain traces of starch. The fruits also contains a fixed oil, red colouring matter which is non-pungent and yield 20-25 % alcoholic extract. The constituents (mean) of red chilli as follows: dry matter (22.02%), ascorbic acid 131.06 mg/100 gm (fresh wt.), oleoresin 66.53 ASTA units, colouring matter 67.38 ASTA units, capsaicin 0.34% (dry wt.), crude fibre 26.73 % and total ash 6.69 %. Chillies contain are impressive list of plant derived chemical compound are known to be have disease preventing and health promoting properties. Early laboratory studies on experimental mammals suggested that capsaicin has anti bacterial, anti carcinogenic, analgesic and anti diabetic properties. It also found to reduce LDL cholesterol levels in obese individuals. They are also good in other antioxidant like vitamin-A and flavonoids like beta carotene, lutein, zeaxanthin, and cryptoxanthin. These antioxidant substance in capsicum help to protect the body from injurious effect of free radicals generated during stress and diseases conditions. Chillies contain a good amount of mineral like Potassium, manganese, iron and magnesium and potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese acts as co-factor for the antioxidant enzyme, superoxide dismutase. Chillies are also good in B- complex group of vitamins such as niacin, pyridoxine, riboflavin and thiamin. 100 g red pepper provides about 127.7 µg that constitute about 213% of RDA of vitamin C. Vitamin-C is a potent water soluble antioxidant and inside the human body, it is required for the collagen synthesis. Regular consumption of foods rich in vitamin C helps the human body protect from scurvy; develop resistance against infectious agents (boosts immunity) and scavenge harmful, pro-inflammatory free radicals from the body. Both hot and sweet peppers contain substances that have been proved to increase the body's heat production and oxygen consumption for about 20-30 minutes after eating that indicates our body is burning extra calories, which helps weight loss.

Nutritional and Medicinal Properties in Potato

Potatoes are considered as comfort food which is mashed, baked or roasted. Potato ranks as the third most important food crop after wheat and rice. It is an important food staple and the number one vegetable crop in the world because it yields on average more food energy on a per hectare and a per day basis than either cereals or cassava. The predominant form of this carbohydrate present in potato tuber is starch. Its small but major portion of this starch is resistant to digestion by enzymes in the stomach and small intestine therefore it reaches the large intestine essentially intact. Such resistant starch is considered to have physiological effects and health benefits as

dietary fiber. These are considered to provides bulk, offers protection against colon cancer, improves glucose tolerance and insulin sensitivity, lowers plasma cholesterol and triglyceride concentrations, increases satiety, and even reduces fat storage. Potato tuber also contains a small amount of protein (less than 6%), but its biological value of protein is considered the best among vegetable sources and comparable to cow's milk. Potatoes also contain a variety of phytonutrients that have antioxidant activity. Among these health-promoting compounds are carotenoids, flavonoids and caffeic acid, as well as unique tuber storage proteins called as patatin, which has activity against free radicals. In the institute for Food Research, UK has identified blood pressure lowering compounds in potato which is called as kukoamines. Chlorogenic acid constitutes up to 90% of the potato tuber natural phenols. Others phytochemicals found in potatoes are 4-O-caffeoylquinic acid (cryptochlorogenic acid), 5-O-caffeoylquinic (neochlorogenic acid), 3,4-dicaffeoylquinic and 3,5-dicaffeoylquinic acids. A medium-size 130-150 g potato with the skin provides 27 mg of vitamin C, 620 mg of potassium, 0.2 mg vitamin B6 and trace amounts of thiamin, riboflavin, folate, niacin, magnesium, phosphorus, iron, and zinc. The fiber content of a potato with skin (2 g) is considered equivalent to that of many whole grain cereals. Potato contains a moderate amount of vitamin C (10 to 104 mg/kg) and its concentration depends on the cultivar and the growing season, but it declined rapidly (30 to 50 percent) during storage and cooking. Other important antioxidants found in potato tuber include 0.5 to 2.8 mg/kg α -tocopherol, 0.13 to 0.6 mg/kg lutein, and 1 mg/kg β -carotene. Potato tuber also contributes a small amount of selenium (0.01 mg/kg) and folate (0.35 mg/kg) to the human diet. Potato is also rich source of vitamin B6 is involved in many enzymatic reactions. Many of the building blocks of protein, amino acids, require B6 for their synthesis. *Heme* (the protein center of our red blood cells) and *phospholipids* (cell membrane components that enable messaging between cells) also dependent on vitamin B6 for their creation. B6 is also necessary for the creation of *amines* that acts as messaging molecule or neurotransmitter. It plays another critically important role in *methylation*. For the breakdown of glycogen vitamin B6 is necessary so this vitamin is a key player in athletic performance and endurance.

Table 1: Nutritional value of solanaceous vegetable crops (per 100 g)

Content	Brinjal	Tomato	Potato	Capsicum
Energy	24 Kcal	18 Kcal	70 Kcal	31 Kcal

Carbohydrates	5.7 g	3.9 g	15.90 g	6.03 g
Protein	1 g	0.9 g	1.89 g	0.99 g
Total Fat	0.19 g	0.2 g	0.10 g	0.30 g
Cholesterol	0 mg	0 mg	0 mg	0 mg
Dietary Fiber	3.40 g	1.2 g	2.5 g	2.1 g
Folates	22 µg	15 µg	18mg	46 µg
Niacin	0.649 mg	0.594 mg	1.149 mg	0.979 mg
Pyridoxine	0.084 mg	0.080 mg	0.239 mg	0.291 mg
Riboflavin	0.037 mg	0.034mg	0.038 mg	0.085 mg
Thiamin	0.039 mg	0.037 mg	0.081 mg	0.054 mg
Vitamin A	27 IU	833 IU	7 IU	3131 IU
Vitamin C	2.2 mg	13 mg	11.4 mg	127.7 mg
Vitamin E	0.30 mg	0.54 mg	-	1.58 mg
Vitamin K	3.5 µg	7.9 µg	2.9 mg	4.9 µg
Sodium	2 mg	5 mg	6 mg	4 mg
Potassium	230 mg	237 mg	455 mg	211 mg
Calcium	9 mg	10 mg	10 mg	7 mg
Iron	0.24 mg	0.3 mg	0.73 mg	0.43 mg
Manganese	0.250 mg	0.15 mg	22mg	12 mg
Zinc	0.16 mg	0.17 mg	0.33 mg	0.25 mg
Carotene-β	-	449 µg	4 mcg	1624 µg
Carotene-a	-	101 µg	0 mcg	20 µg
Lutein-zeaxanthin	-	123 µg	21 mcg	490 µg
Lycopene	-	2573 µg	4 mcg	51 µg

(Source: USDA National Nutrient data base)

Table 2: Phytochemicals present in solanaceous vegetable crops

Sl. No.	Crop	Scientific name	Nutritional compounds	Nutritionally enriched improved cultivar
1	Tomato	<i>Solanum lycopersicum</i> L.	Lycopene, phytoene, neurosporene	Pusa Rohini
2	Brinjal	<i>Solanum melongena</i> L.	Nasunin, chlorogenic acid, Linoleic and Linolenic acid	Pusa Purple Long, Pusa Kranti
3	Capsicum	<i>Capsicum annuum</i> L.	Capsaicinoids	KTPL-19

4	Potato	<i>Solanum tuberosum</i> L.	Carotenoids, flavonoids, caffeic acid	-
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SUMMARY

Regular consumption of a solanaceous vegetables rich diet has undeniable positive effects on health since phytonutraceuticals of these vegetables can protect the human body from several types of chronic diseases. Various phytonutraceuticals with antioxidant present in these vegetables may work directly by quenching free radicals or indirectly by participating in cell signaling pathways sensitive to redox balance. Nutrients such as potassium contribute to blood pressure regulation and its availability in these vegetables are in plenty. The dietary fiber present in tomato, peppers, brinjal and potato may also contribute to the overall health benefit, such as improving bowel transit, lowering cholesterol, helping manage blood glucose concentrations, and by transporting a significant amount of minerals and phytochemicals linked to the fibre matrix through the human gut. Increasing these vegetables in the diet may reduce the intake of saturated fats, trans fats, and foods with higher caloric density, all of which may be related to a healthier overall diet. Because these vegetable contains a unique combination of phytonutraceuticals (vitamins, minerals, dietary fiber and phytochemicals), a great diversity of these vegetables should be eaten to ensure that individual's diet includes a combination of phytonutraceuticals and to get all the health benefits. The availability of a large diversity of solanaceous vegetables year round, allied to increase in mean per capita incomes in recent years and knowledge of vegetable health benefits, have enable consumers to include a variety of health promoting phytonutraceuticals in their diet. These vegetables are served in each and every plate of India either cooked or raw. Nutritional quality as understood by the consumers and available at a moderate price may encourage enhanced consumption, thereby conferring an important marketing incentive.

References (if any)

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