



## Review Article

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### SWEET POTATO AS A SUPER-FOOD

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#### ABSTRACT

Sweet potato (*Ipomoea batata* Lam), is an extremely versatile and delicious vegetable that possesses high nutritional value. Sweet potato has been grown in tropical and subtropical regions throughout the world, since ancient times. From the times immemorial, the whole sweet potato plant including leaves, stem and tuberous root is used as a traditional medicine. Nowadays, Sweet potato is preferred over other vegetables due to its multifaceted medicinal properties. The medicinal properties of sweet potato include anti-cancer, anti-diabetic, anti-inflammatory, anti-oxidant, anti-bacterial, anti-fungal, anti-viral, anti-ulcer, hepatoprotective, wound healing, and immunomodulatory activities. Sweet potatoes can alleviate muscle cramps due to their high potassium content which are often related to potassium deficiency. Sweet potatoes contain magnesium, a crucial mineral, which promotes relaxation, calmness and nerve health. Overall objective of this review article is to give a brief knowledge about the nutritional value, health benefits, phytochemical composition, pharmacological actions and medicinal properties of sweet potato. Sweet potato holds first rank (super food) in nutrition among vegetables.

**Keywords:** Sweet potato, *Ipomoea batata*, nutraceutical, anti-oxidant, anti-diabetic.

#### INTRODUCTION

Sweet potato holds first rank (super food) in nutrition among vegetables. Sweet potato is one of the oldest vegetable known to mankind. It is believed to be in consumption for centuries. Its history dates back to 750 B.C. in Peruvian records. Sweet potato is a large, starchy, tuberous root vegetable. Each and every part of the sweet potato, especially the tuber is beneficial for society. This dicotyledonous plant belonging to the family Convolvulaceae is scientifically known as *Ipomoea batatas* L (Table 1). Several species of this plant have been commonly used in religious rituals and also for ornamental and medicinal purposes. Sweet potato is now being recognized as a health food due to several of its nutraceutical components and carotenoids. Sweet potato contains magnesium, the key mineral for de-stressing and good mood. It also promotes artery, bone, muscle, and nerve health. Sweet potato varieties may be 'firm' or 'soft'. It is the soft varieties that are often labeled as yam in United States<sup>1</sup>. Herbal medicines appear to be quite effective in treating various clinical disorders furthermore, these herbal drugs are essentially safe<sup>2</sup>.

#### GEOGRAPHICAL DISTRIBUTION<sup>3</sup>

It is widely cultivated in tropical, subtropical and temperate regions of the world.

**World scenario:** It is cultivated in China, Uganda, Nigeria, Indonesia, Tanzania, Vietnam, India, United States (Table 2).

**Indian scenario:** It is widely cultivated in different states of India such as Orissa, U.P, West Bengal, Punjab, Haryana, Madhya Pradesh, Maharashtra, Gujarat, Assam, Chhattisgarh, Karnataka, Meghalaya, Nagaland, Bihar, Tamil Nadu, Andhra Pradesh, Kerala, Rajasthan, Mizoram, Andaman & Nicobar, Pondicherry (Table 3).

#### HISTORY

Sweet potato is one of the oldest vegetables known to mankind. It is believed to be in consumption for centuries. Its history dates back to 750 B.C. in Peruvian records. Sweet potatoes are native to South America and have been cultivated there for over 5000 years. They were also known in pre-Columbian times in Polynesia as early as 1200 A.D. Sweet potato had been already a principle food of the Maoris in New Zealand during that period. Christopher Columbus introduced sweet potatoes to Europe following his first voyage to the New World in 1492 and that they were cultivated in Spain as early as 1500 A.D. By the 16th century, Spanish explorers took the sweet potatoes to the Philippines and East Indies, from where it easily spread to India, China, Africa, Indonesia, and southern Asia, probably with the assistance of Portuguese traders. In the mid-20th century, the softer, orange fleshed sweet potato was introduced to North America and given the name "yam" to distinguish it from the firmer, white variety. Sweet potato varieties with white or pale yellow flesh are less sweet and moist than those with red, pink or orange flesh. Based on the production volume, sweet potato ranks as seventh and fifth most important food crops in the world and

developing countries, respectively. Today, the main commercial producers of sweet potatoes are China, Indonesia, Vietnam, Japan, India, and Uganda. Yams are closely related to lilies and grasses native of Africa and Asia. African slaves had already been calling the 'soft' sweet potatoes as 'yams' because they resembled the yams in Africa. Sweet potato varieties may be 'firm' or 'soft'. It is the soft varieties that are often labeled as yam in United States <sup>4</sup>.

### CULTIVATION AND COLLECTION

The crop is widely grown in tropical, subtropical and temperate areas between 40° N and 32° S. The plant does not tolerate frost. It grows best at an average temperature of 24 °C (75 °F), abundant sunshine and warm nights. Annual rainfalls of 750–1,000 mm (30–39 in) are considered most suitable, with a minimum of 500 mm (20 in) in the growing season. Heavy rainfall, high temperature and excess cloudiness encourage vegetative growth. In sweet potato, close spacing is generally recommended to achieve maximum root yield. Though sweet potato covers the soil quickly, weeding is necessary, particularly, in the early stages of the crop growth (Table 4).

#### Soil

- Sweet potatoes are grown on a variety of soils, but well-drained, light- and medium-textured soils with a pH range of 4.5-7.0 are more favorable for the plant.
- Application of phosphorous and potassium are recommended during field preparation.

#### Irrigation

- The efficient method of irrigation of sweet potato is drip irrigation.

#### Storage

- Sweet potatoes should be stored at 80 to 90% relative humidity and 55°F
- Store in a cool, dark place with good ventilation. Use within 2 weeks. Do not store in the refrigerator.

The Phytoconstituents of sweet potato have been tabulated in Table 5<sup>5,6</sup>.

### SPORAMIN AS A STORAGE PROTEIN

The initial investigation of the nature of the proteins in the tuber of sweet potato (*Ipomoea batatas* Lam.) revealed a globulin-designated "ipomoein," which was reported by Jones and Gersdorff, (1931)<sup>8</sup>. Later, "ipomoein" was renamed "sporamin" and was found to be a major storage protein that accounted for about 60% to 80% of total soluble protein in sweet potato tubers. Storage proteins are the most abundant proteins in storage tissue. In general, storage proteins display a tissue-specific expression pattern, such as in seeds, tubers and bark. Storage proteins serve as a nutritional resource for plants

by providing an essential source of nitrogen and amino acids during growth and development, especially during seed germination and tuber re-growth. Moreover, many storage proteins have been shown to possess the enzymatic activities that are related to plant defences against threats such as insects, plant diseases and abiotic stress. <sup>7</sup>

### TRADITIONAL USES

Sweet potatoes are used in the treatment of tumors of the mouth and throat. Decoctions of the leaves can be used as an aphrodisiac, astringent, demulcent, laxative, energizer, bactericide and fungicidal agent. Sweet potato has been found to be beneficial in treating asthma, bugbites, burns, catarrh, convalescence, diarrhea, fever, nausea, splenosis, stomach distress, tumors, and whitlows (an infection of tip of finger). There have been anecdotal reports of the use of *Ipomoea batatas* in dengue, producing improvement in platelet counts. In region of Kagawa, Japan, a variety of white sweet potato (Table 6 for Varieties of Sweet Potato<sup>2</sup>) has been eaten raw to treat anemia, hypertension and diabetes<sup>9</sup>.

Pharmacological activities of sweet potato are summarized in Table 7.

#### Anti-diabetic activity

Despite its "sweet" name, it may be beneficial for diabetes according to some studies, since it helps in stabilizing blood sugar levels & lowers insulin resistance. The extract of white skinned sweet potato (WSSP) called Caiapo reduces insulin resistance, when administered in appropriate dose. The anti-diabetic activity of WSSP versus troglitazone was examined in rats over 8 weeks.

### MISCELLANEOUS USES

- Tubers are used in starch and industrial alcohol production.
- In South America, the juice of red sweet potatoes is combined with lime juice in varying proportions to make a dye for cloth (pink to black).
- All parts of the plant can be used for animal fodder.
- Sweet potatoes are often found in ceramics.
- Several species of cultivated in gardens as ornamental plants for their attractive foliage.
- George Washington Carver developed 118 products from sweet potatoes, including glue for postage stamps and starch for sizing cotton fabrics, and an alternative to corn syrup.

### STRANGE FACTS

Sweet potato holds first rank (super- food) in nutrition among vegetables. Sweet potatoes, when eaten with the skin, have more fiber than oatmeal. Sweet potatoes can. They protect cigarette smokers from emphysema and help in fetal development, alleviate muscle cramps, which are often related to potassium deficiency due to their high potassium content. Sweet potatoes contain magnesium, a crucial mineral for de-stressing, which promotes

relaxation, calmness and nerve health. As a nutraceutical, sweet potatoes can be formulated into semi-solid food products such as beverages, soups, baby foods, ice creams, baked products, breakfast cereals, and desserts.

## CONTRAINDICATIONS AND PRECAUTIONS

Sweet potato is contraindicated in patients, who are hypersensitive to sweet potato or its products. People with a history of kidney stones may want to avoid eating too many sweet potatoes, as the vegetable contains oxalate, which contributes to the forming of calcium-oxalate kidney stones.

**Table 1: Taxonomical Classification of Sweet Potato**

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyte
Division	Sagnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Solanales
Family	Convolvulaceae
Genus	<i>Ipomoea</i> L.-morning glory family
Species	<i>I.batatas</i> (L.)

**Table 2: International Synonyms of Sweet Potato**

S/No	Name	Language	Country/Region
1	Batata hhlwah	Arabic	Middle East, North Africa
2	Pua, Tipali, Tuctuca	Aymara	Bolivia, Peru, Chile
3	Kan-swun:kri; U.kan-swun:	Burmese	Burma
4	Fan shu (Faan syu), Bai shu, Gan shu(kan chou)	Chinese	China
5	Sod kartoffel, Batat	Danish	Denmark, Greenland
6	Zoete aardappel, Bataat	Dutch	Netherlands, South Africa
7	Sweet potato, sweetpotato(USA), Kumara(NZ), Yam(USA)	English	England, USA, New Zealand
8	Patate douce	French	France
9	SuBkartoffel, Suesskartoffel, Batate	German	Germany
10	Glikopatata	Greek	Greece, Cyprus
11	Mitha alu, Sakarkand, Shakar kanda	Hindi	India
12	Patata dolce	Italian	Italy
13	Satsuma imo, Ryuukyuu imo, Kara imo, Kan sho	Japanese	Japan
14	Ko gu ma	Korean	Korea
15	Ubi keladi, Ubi keladek, Ketela rambat (Java), Ubi jalar( Indonesia)	Malay	Malaya, Indonesia
16	Batata doce, Batata da ilha(Brazil)	Portuguese	Portugal
17	Batata, Boniato, Camote(Latin America), Cumala huasca, Cumara, Curiti, Kamote(Philippines)	Spanish	Spain
18	Huwi boled	Sundanese	West Java, Jakarta, Banten
19	Manthet	Thai	Thailand
20	Khoai lang, Khoai mon	Vietnamese	Vietnam

**Table 3: Indian Synonyms of Sweet Potato**

S/No	Name	Language	State/Region
1	Mishti Alu	Bangali	West Bengal
2	Sakarkand, Shakar kanda, Ratalu	Hindi	North India(Haryana, Delhi, etc)
3	Genasu	Kannada	Karnataka
4	Mathura kizhangu	Malayalam	Kerala
5	Ratala	Marathi	Maharashtra
6	Sakkara valli kilangu, Carkkaraivalli, Ciignikkilangu, Vattaalagn kilangu, Vellikkilangu	Tamil	Tamil Nadu
7	Chilakada dumpa	Telgu	Andhra Pradesh

**Table 4: Botanical Description of Sweet Potato**

Flower character	Monoecious
Edible parts	Storage root
Shape of root	Short, blocky, tapered ends
Roots per plant	4–10
External texture of edible storage organ	Smooth, thin skin
Taste	Sweet, Moist

**Table 5: Phytoconstituents of *Ipomoea batata* <sup>5,6</sup>**

Sr.	Phytoconstituents	Plant Part
1	<b>Phenolic acids</b> - Caffeic acid, Caffeoylquinic acid derivatives (chlorogenic acid, isochlorogenic acid, dicaffeoylquinic acid, tricaffeoylquinic acid, hydroxyl cinnamic acid and neochlorogenic acid).	Leaf, Root, Peel
2	<b>Coumarins</b> -Scopolatin, Esculetin, Umbelliferone, Peonidin, cyanidins.	Leaf, Root
3	<b>Triterpenes/Steroid</b> -Beta-amirin acetate, Boehmerylacetate, Friedelin	Root, Leaf
4	<b>Sesquiterpenoids</b> -6-myoporol, 4-hydroxy-dehydro-myoporone and ipomeamarone(most abundant)	Root
5	<b>Alkaloid</b> -CalystegineB1, Calystegine B2, Calystegine C1, Calystegine B3, Ipomine	Tuber root, Leaf
6	<b>Carbohydrates</b> -Starch, Sugars, Dietary fiber	Root
7	<b>Vitamins</b> -Vitamin A, Vitamin C, Vitamin B1(Thiamine), Vitamin B2(Riboflavin), Vitamin B3(Niacin), Vitamin B5(Pantothenic acid), Vitamin B6, Vitamin B9(Folate), Vitamin E, and Vitamin K.	Root, Leaf
8	<b>Minerals</b> -Magnesium(Mg), Copper(Cu), Phosphorous(P), Calcium(Ca), Iron(Fe), Manganese(Mn), Potassium(K), Sodium(Na), Zinc(Zn)	Root, Leaf
9	<b>Storage protein</b> -Sporamin/ipomoein,	Root
10	<b>Anthocyanins</b> -Carotenoids(beta-carotene, Lutein)	Root, Leaf
11	<b>Tannins</b> -Phlobatannin	Root, Leaf
12	<b>Flavonoids</b> - Tilioside, Astragalin, Rhamnocitrin, Rhamnetin and Kaempferol	Leaf
13	<b>Saponins</b>	Leaf
14	<b>Enzyme</b> - Chitinases	Leaf
15	<b>Glycosides</b> - Batatins (including batatin I and batatin II), batatosides (including batatoside III, batatoside IV, and batatoside V)	Leaf, Root

**Table 6: Varieties of Sweet Potato<sup>3</sup>**

<b>Orange-fleshed*</b>	Beauregard B-63, Beauregard B-14, California Gold, Carolina Ruby, Covington, Evangeline, Gold Nugget, Bienville, Hernandez, Hertogold, Jewel, LA07-146, Orleans.
<b>Purple-fleshed</b>	Agena, Japanese Purple, Korean Purple, Mokuau, Okinawan, Purple.
<b>White-fleshed</b>	Bonita, Murasaki-29, Uyentan, Dingess, Brazilian, Batas, Hayman, O'Henry.

\*Most sweet potato cultivars that contain the word "gold" or the word "red" in their title are orange-fleshed varieties.

**Table 7: Pharmacological Activities of Sweet Potato (*Ipomoea batata*)**

Pharmacological Activities	Plant Parts	Extracts	References
<b>1 Anti-infective</b>			
i. Anti-fungal	Root	Acetone extract	10
ii. Anti-viral	Leaf, Root, Peel	Alcoholic and Aqueous extract	11
iii. Anti-microbial	Leaf	Ethanol crude leaves extract	12, 13
<b>2 Anti-cancer</b>			
i. Anti-tumor	Leaf	Aqueous and Alcoholic extract	14
ii. Anti-proliferative	Leaf, Root	Aqueous extract	15
iii. Anti-cancer	Leaf	Methanol extract	16
iv. Colorectal cancer prevention	Root	Sweet potato protein extract(aqueous, alcoholic)	17
v. Anti-mutagenic	Leaf, Sweet potato root	Aqueous extract	18
<b>3 Inflammatory diseases</b>			
i. Anti-inflammatory	Dried aerial part	Aqueous extract	19
ii. Anti-ulcer	Root	Butanol extract, sweet potato flour	20, 21
iii. Wound healing	Peel, Leaf, Root	Peel extract gel	22
<b>4 Diabetes</b>			
i. *Anti-diabetic	Transgenic sweet potato whole plant (mainly leaf)	Aqueous, alcoholic extract	23, 24
ii. Hypoglycemic	Root	Acetic acid extract of white skinned sweet potato	25
<b>5 Atherosclerotic lesions</b>	Purple sweet potato root	Chloroform, Methanol, Ethyl acetate extract	26
<b>6 Miscellaneous</b>			
i. Anti-oxidant	Leaf, Root	Methanolic extract	27, 28
ii. Oxidative stress	Root	Aqueous, Methanol extract	29
iii. Immunomodulatory	Root	Aqueous extract	30
iv. Ultra-violet protection	Leaf, Root, Whole plant	Aqueous, Ethanol extract	31
v. Hepatoprotective	Whole plant	Aqueous extract	32

\*Despite its "sweet" name, it may be beneficial for diabetes according to some studies, since it helps in stabilizing blood sugar levels & lowers insulin resistance. The extract of white skinned sweet potato (WSSP) called Caiapo reduces insulin resistance, when administered in appropriate dose. The anti-diabetic activity of WSSP versus troglitazone was examined in rats over 8 weeks.

**Table 8: Nutritional Value of Sweet Potato For Edible Portion**

Nutrients	Units	Value per 100 grams
Water	G	77
Energy	Cal	90
Carbohydrate	G	20.7
Starch	G	7
Dietary	G	3.3
Fat	G	0.1
Protein	G	1.6

Sugar	G	4.2
<b>Minerals</b>		
Calcium	Mg	30
Iron	Mg	0.6
Magnesium	Mg	25
Manganese	Mg	0.258
Phosphorus	Mg	47
Potassium	Mg	475
Sodium	Mg	55
Zinc	Mg	0.3
<b>Vitamins</b>		
Vitamin A	mcg	1921.80
Thiamine B1	Mg	0.1
Riboflavin B2	Mg	0.1
Niacin B3	Mg	0.8
Pantothenic acid B5	Mg	0.8
Vitamin B6	Mg	0.2
Vitamin B9	mcg	11
Vitamin C	Mg	2.4
Vitamin E	Mg	0.26
Vitamin K	mcg	302.2
<b>Amino-acid</b>		
Threonine	G	4.0
Valine	G	5.0
Methionine	G	2.2
Isoleucine	G	4.2
Leucine	G	4.8
Tyrosine	G	2.8
Phenylalanine	G	2.8
Lysine	G	4.2
Tryptophan	G	1.4
Aspartic acid	G	22.43
Serine	G	5.47
Glutamic acid	G	10.98
Proline	G	2.54
Glycine	G	4.29
Alanine	G	3.56
Histidine	G	3.09
Arginine	G	4.17
<b>Lipids</b>		
Beta-carotene	mcg	8509



Homely dishes of sweet potato

## CONCLUSION

Sweet potato is considered as a super- food, when compared to other vegetables due to its versatile and delicious taste and high nutritional value. Nowadays, Sweet potato is preferred over other vegetables due to its multifaceted medicinal properties. The medicinal properties of sweet potato include anti-cancer, anti-

diabetic, anti- inflammatory, anti-oxidant, anti-bacterial, anti-fungal, anti-viral, anti-ulcer, hepatoprotective, wound healing, and immunomodulatory activities. Sweet potatoes protect cigarette smokers from emphysema. Sweet potatoes can alleviate muscle cramps due to their high potassium content. Sweet potatoes contain magnesium, a crucial mineral, which promotes relaxation, calmness, and mood and nerve health.

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