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Literature Review on *Ipomoea batatas* (L.) *Lam*

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ABSTRACT

The plant *Ipomoea batatas* (L.) *lam* belonging to the family Convolvulaceae, commonly known as Sweet potato, has attracted due to its numerous medical benefits, it has gained fame on a global scale recently. Sweet potato has been extensively used in Ayurveda, Unani and Homoeopathic medicine and has become a cynosure of modern medicine. The plant produces a variety of bioactive secondary metabolite to possess diverse number of pharmacological activities. The review reveals that wide range of phytochemical constituents have been isolated from this plant and it possesses important activities like antioxidant, antimicrobial agent, anti-inflammatory, anti-arthritic, hypolipidemic, antidiabetic, hematinic, anti-proliferative, cytotoxic, diuretic, wound healing, hepatoprotective, anti-mutagenic and anti-carcinogenic, immunomodulatory activities have also been reported. This review summarises the wide range of phytochemical and pharmacological activities of Sweet potato.

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INTRODUCTION

Health and disease are two important areas which have engaged attracted the attention of mankind since time immemorial. Herbal medicine is the foundation for about 75-80% of the World population, mainly targeting primary health care for in the developing countries because of better cultural acceptability, compatibility with human body and lesser side effects. However, there is a drastic increase in the usage of herbal medicine was found in last few years from the developed countries[1]. The World Health Organization (WHO) has also recommended the evaluation of plants for effectiveness against human diseases and for the development of safe modern drugs[2]. Indeed, nearly 25% of today's conventional drugs originated directly or indirectly from plants[3]. In traditional medicine, there are many natural crude drugs that have the potential activity to treat many disease and disorders one of them is *Ipomoea batatas*(L.) *lam* is a dicotyledonous plant that belongs to the Convolvulaceae[4]. The origin of this plant, there is a famous folktale a Sinhala. The plant is commonly seen growing in all parts of India and some other European and American countries[5]. This review focuses on the phytochemistry and pharmacological activities of this plant.

PLANT PROFILE:

PLANT NAME: *Ipomoea batatas* (L.) *lam*

FAMILY: Convolvulaceae

SYNONYMS:

Convolvulus tiliaceus auct,Ipomoea fastigiata (Roxb.), Ipomoea tiliacea auct.non (Willd.)Choisy, Ipomoea triloba auct.non L, Convolvulus batatas L.

COMMON NAME: Sweet potato, morning glory, moonflower, bindweed[6].

TOXONOMY

Kingdom: Plantae

Subkingdom: Tracheobionta

Super division: Spermatophyte

Division: Magnoliophyta

Class: Magnoliopsida

Sub class: Asteridae

Order: Solanales

Family: Convolvulaceae

Genus: *Ipomoea L.*

Species: *Ipomoea batatas* (L.) *Lam*[7]

VERNACULAR NAMES

Tamil: Sarkaraivallikizangu, Cini-k-kilanku.

English: Sweet potato

Kannada: Sihigensu

Hindi: Shakarkand

Telugu: Genusugadda

Gujarati: Ratalu

Malayalam: Madhurakkilannu

Sanskrit: Sukari[8]

DESCRIPTION

Ipomoea batatas (L) Lam) is a native of tropical America. It is consumed as a staple food in several countries. It is an important food crop in tropical and sub-tropical countries and grown on a large scale in China, Tanzania, Central and South America, Mexico, Mediterranean regions of Europe, Africa, India, South East Asia and the Pacific islands. The sweet potato is a twining, trailing perennial vine with adventitious roots that end in swollen tubers. It requires a sandy soil and a warm moist climate. It is one of the most drought resistant vegetables in the world. Perennial plant grown as an annual under cultivation.

Vines

The vines are either green or red or purple in colour and about 4-16 feet (4m) long. The vines may be hairy, especially at the nodes. It offers sweet edible tubers and leaves and attractive foliage.

Leaves

They are heart shaped, with the margins either toothed or entirely or deeply lobed. In some varieties the leaves may be tinged with a slight purple.

Flowers

They are funnel shaped and either bluish or purple[5].

Tubers

The plant has enlarged roots called tubers which act as an energy store for the plant. The tubers can be variable in shape and can be red, yellow, brown, white or purple in colour[8].

PHYTOCHEMICAL CONSTITUENTS

Sweet potato roots and tops possess a variety of chemical compounds relevant to human health. About 80 to 90 % of sweet potato dry matter is made up of carbohydrates, contains mainly of starch (60-70%) and less amounts of pectins, hemicelluloses and cellulose.

Sweet potato also contains protein (0.46%-2.93%), dietary fiber (0.49%-4.71%), lipid (0.06%- 0.48%) and ash (0.31%-1.06%).

It also contains the mineral such as Ca, Fe, S, Cu, Zn, P, Mg, Na, K, Mn, Al and B.

Sweet potato is a important source of vitamin A, thiamine, riboflavin, niacin, ascorbic acid, β -carotene and many other functional compounds.

Sweet potato leaves are excellent source flavonoids, anthocyanins and phenolic acids such as caffeic, monocaffeoylquinic (chloro-genic), dicaffeoylquinic and tricaffeoylquinic acids.

The major constituent flavonoids is proanthocyanins and two or more flavan-3-ol such as catechin, epicatechin or gallocatechin. Catechin contains 2 benzene rings to be the powerful scavenger[9].

TRADITIONAL USES

Sweet potato is an extremely versatile and delicious vegetable that possess high nutritional value. In around world, sweet potatoes have been grown in tropical and subtropical areas. From the times immemorial, the whole sweet potato plant including leaves, stem, and tuberous root is used as traditional medicine. Due to its diverse variety of benefits, sweet potatoes are now chosen above other vegetables. The medicinal properties of sweet potato include antioxidant, antimicrobial agent, anti-inflammatory, anti-arthritic, hypolipidemic, antidiabetic activity, hematinic, anti-proliferative, cytotoxic, diuretic, wound healing, hepatoprotective, anti-mutagenic and anti-carcinogenic, immunomodulatory activities. Sweet potato is production for fuel bioethanol. Magnesium is a vital mineral found in sweet potatoes which helps in relaxation. In Ayurvedic, Sweet potato leaves applied to boils and acne, boiled roots used for diarrhoea, hot water infusion of the whole plant used in the management of diabetes mellitus [10-26].

LEAVES FLOWERS

TUBERS VINES

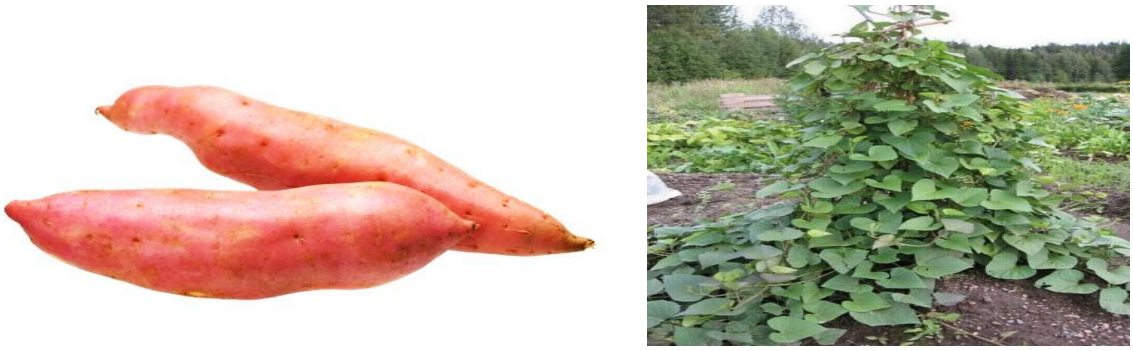

Fig.1: Parts of Ipomoea batatas (L.) lam

PREVIOUS PHARMACOLOGICAL INVESTIGATION

ANTIMICROBIAL ACTIVITY

Antimicrobial activities of the crude leaves extract of sweet potato (SP) leaves have been studied. Agar disc and agar well diffusion tests were used to measure antimicrobial activity. For antimicrobial studies, neither concentration of the SP freeze dried extract was able to inhibit the growth of *Streptococcus mutans*, *Streptococcus mitis*, *Staphylococcus aureus*, and *Candid albicans* in both agar disk and agar well diffusion tests. SP leaves showed the presence of possible secondary metabolites with potential biological activities. Neither antimicrobial activity was observed[12].

ANTI-INFLAMMATORY AND ANTI-ARTHRITIC ACTIVITY

Dry powder of *Ipomoea batatas* tuber and roots were extracted with ethyl acetate (IPT-EA, IPR-EA) and methanol (IPT-M, IPR-M) respectively. These extracts were tested for total phenolic and flavonoid contents (TPC and TFC). Maximal dry extract of TPC and TFC were respectively 319.81 ± 14.20 µg GAE/mg, 208.77 ± 9.09 µg QE/mg in IPR-EA extract. IPR-EA and IPT-EAdry extract yielded the maximum amounts of rutin (4.5 ± 0.55and7.3 ± 1.12), caffeic acid (2.17 ± 0.26and1.60 ± 0.25) and myricetin (1.01 ± 0.08 and2.7 ± 0.14µg/mg) respectively in HPLC-DAD analysis. Better inhibition of albumin denaturation was shown by IPT-EA($76.92 \pm 3.07\%$) in comparison to ibuprofen ($79.48 \pm 4.71\%$). IPR-EA exhibited highest edema inhibition in carrageenan-induced paw edema model ($79.11 \pm 5.47\%$), croton oil-induced ear ($72.01 \pm 7.80\%$) and anal edema ($70.80 \pm 4.94\%$). Significant inhibition of CFA-induced arthritic edema and arthritic score were observed by IPR-EA as compared with ibuprofen. Inhibition of pro-inflammatory cytokines (IL-1β, IL-6) and NO levels was shown by IPR-EA and IPT-EA, respectively. *Ipomoea batatas* is anti-inflammatory and anti-arthritic agent[13].

HYPOGLYCEMIC AND HYPOLIPIDEMIC ACTIVITY

Evaluate the lipidemic effect of methanol extract of Ipomoea batatas.18 adult female wistar albino rats were grouped into 6 groups (n=3). Group 1 served as control while group 2 was administered gilbenclamide. Groups 3, 4, 5 and 6 were administered 1000 mg/kg, 750 mg/kg, 500 mg/kg and 250 mg/kg body weight of the extract daily. The administration was done for a period of 7 days and the animals were sacrificed, blood collected and serum collected for laboratory analysis. The result of analysis shows a significant ($p<0.05$) decrease in blood

sugar level in the extract treated groups when compared with the normal control. The lipid profile test also show a significant ($p<0.05$) decrease in VLDL and TAG in the treated group when compared with the normal control. This work shows that I. batatas is a good anti-lipidemic plant and will also serve as a good means of diabetes management[14].

ANTIDIABETIC ACTIVITY

Antidiabetic potential of the leaves of *Ipomoea batatas* have been investigated. The crude powder, 95% ethanolic, 50% ethanolic and aqueous extracts of *Ipomoea batatas* leaves were administered to normoglycemic and streptozotocin (STZ)-induced diabetic rats in a single dose study. The aqueous extract showed significant lowering of postprandial hyperglycemia of post sucrose loaded normal rats and significantly declined the blood glucose level of STZ-induced diabetic rats. The aqueous fraction at a single dose of 100 mg/kg compared with chloroform and butanol fractions significantly lowered the blood glucose level of STZ-induced diabetic rats. The aqueous fraction in a multiple dose study were found to significantly improved the percent glycated hemoglobin (%HbA1c), fasting blood glucose, oral glucose tolerance test (OGTT), serum insulin, lipid profile, liver and kidney parameters in STZ-induced diabetic rats. Marked improvement in OGTT and serum insulin levels was also found in neonatal STZ-induced diabetic rats. The study was demonstrated the significant antidiabetic activity of the *I. batatas* leaves by promoting insulin secretion, alpha glucosidase and aldose reductase enzyme inhibition[15].

HAEMATINIC ACTIVITY

Study the effect of sweet potato leaf extract on some haematological parameters using rabbits. Sweet potato leaf has haematinic effects and has been used in the treatment of anaemia and other related ailments. To feed rabbits, sweet potato leaves were utilized. The blood samples were collected and analysed for PCV, WBC, platelet count and white cell differential count. There was a significant elevation in PCV, WBC and platelet count ($P<0.05$) respectively. While the differential white cell count remained the same. Increase in haematological parameters after feeding with the sweet potato leave extract may be a direct effect on haemopoietic tissue[16].

ANTIOXIDANT AND ANTI-PROLIFERATIVE ACTIVITY

Possible investigation of antioxidant and antiproliferative activities of the different extracts from sweet potato. In the DPPH assay, ethanol extract of vein had the highest radical

scavenging activity compared than water extract of vein. The highest amount of total phenolic and flavonoid compounds was found in the ethanol extract of vein. The antiproliferative activities of sweet potato were studied *in vitro* using human lymphoma NB4 cells, the water extract of vein had the highest antiproliferative activity with an EC50of 449.6 ± 27.73 µg/ml. Although the ethanol extract of vein showed strong antioxidant activity, it had no antiproliferative activity under the experimental conditions tested[17].

CYTOTOXIC AND ANTIOXIDANT PROPERTY

Evaluate the *in-vitro* cytotoxic and antioxidant properties of ethanolic extract of *ipomoea batatas*. With an EC50 value of 305 g/ml, the extract showed excellent cytotoxic efficacy against DLA cell lines when tested using the trypan blue dye exclusion method. It also exhibited a dose-dependent reduction in cell number at all concentrations examined. The DPPH free radical technique was used to assess the antioxidant activity. With an EC50 of 36.5 g/ml, the extract demonstrated significant antioxidant activity[18].

DIURETIC ACTIVITY

The diuretic activity of aqueous extract of *Ipomoea batatas* root has been studied. The phytochemical analysis of aqueous extract of *Ipomoea batatas* root showed the presence of various phytochemical constituents such as carbohydrates, flavonoids, tannins, phenol. The effect of aqueous extract of root of *Ipomoea batatas* on rats with reference to biochemical changes in serum. The group-II (Standard Hydrochlorothiazide 10 ml/kg, p. o)animals showed significant (P<0.01) increase in total urine volume ml/100gm/hr (10.44 ml). Whereas animals received AEIB significantly (P<0.01) increase in total urine volume ml/100gm/hr(4.44 and 8.06 ml) and significantly (P<0.05) increased total 200& 400 mg/kg doses respectively. The phytochemical studies revealed the presence of carbohydrate, flavonoids, tannins, in the AEIB these may be responsible for its pharmacologicalactivities[19].

ANTIOXIDANT ACTIVITY

The present study was undertaken to evaluate and compare the antioxidant properties of the leaf and carotenoids extract from the *Ipomoea batatas* leaves. Total flavonoids in the leaf extract was 144.6 ± 40.5 µg/g compared to 114.86 ± 4.35µg/g catechin equivalent in the carotenoids extract. Total polyphenols in the leaf extracts (3.470 ± 0.024 GAE g/100g DW) was slightly higher compared to carotenoids extract (2.994 ±0.078 GAE g/100g DW). The carotenoids extract (IC50=491.86 µg/ml) marked a higher radical scavenging capacity when

compared with leaf extract (IC50=545.39µg/ml). Concentration dependent reducing activity was observed for both extracts. Thus, the carotenoids extraction process retained most of the antioxidant capacity when compared with leaves extract of *Ipomoea batatas* [20].

Investigation of radical scavenging effects by DPPH and superoxide anions activity of anthocyanin extract from purple sweet potato. Sixteen kinds of anthocyanins in purple sweet potato was detected by high-performance liquid chromatography with diode-array detection The reducing power of anthocyanin extract was 0.572 at 0.5 mg/ml, while reducing power of L - ascorbic acid (L-AA) and butylated hydroxyl toluene (BHT) were respectively 0.460 and 0.121. Moreover, this anthocyanin extract also could significantly inhibit the formation of lipid peroxidation. Anthocyanin extract from purple sweet potato have a potent antioxidant effect[21].

ANTIULCER ACTIVITY

The antiulcer activity of the tubers of *Ipomoea batatas* (sweet potato) was studied in cold stress and aspirin-induced gastric ulcers in wistar rats. Methanolic extracts of *Ipomoea batatas tubers* two doses like 400 and 800 mg /kg were investigated in cold stress and aspirin-induced gastric ulcer models using cimetidine and omeprazole respectively as standards. Gastroprotective potential, status of the antioxidant superoxide dismutase (SOD), catalase (CAT), glutathione peroxidise (GPx) and glutathione reductase (GR)} along with GSH, and lipid peroxidation were studied in both models. The present study showed that TE possessed gastroprotective activity as evidenced by its significant inhibition of mean ulcer score and ulcer index and a marked increase in GSH, SOD, CAT, GPx, and GR levels and reduction in lipid peroxidation in a dose dependent manner[22].

WOUND HEALING ACTIVITY

The tuber of *Ipomoea batatas* (L.) *lam* contain high levels of polyphenols such as anthocyanins, phenolic acids and vitamins A, B and C which impart a potent antioxidant activity that can possess the wound healing effects. The screening of wound healing property of methanolic extracts of Ipomoea *batatas* tubers (sweet potato) by excision and incision wound models on wistar rats. Three types of gel formulations were prepared, gel containing 3.0% (w/w), 6.0% (w/w), 10% (w/w) peel extract. Betadine (5% w/w povidone iodine cream) was used as a reference standard. In the incision wound model, tensile strength of the skin was measured. Epithelization time, wound contraction, hydroxyproline content of the scab

and ascorbic acid and malondialdehyde content of the plasma were determined in the excision wound model. Significantly elevation of hydroxyproline and ascorbic acid content in the gel treated animals, decrease in malondialdehyde content in the gel as well as peel bandage treated animals was compared with the wounded control animals. It may be concluded that the peels of *Ipomoea batatas* tubers possess a potent wound healing activity which may be due to an underlying antioxidant mechanism[23].

HEPATOPROTECTIVE ACTIVITY

Study the hepatoprotective activity of anthocyanin-rich purple sweet potato extract (APSPE) .16 mice were divided into six groups at randomly. They are negative control group (with CCl_4 only), control group [without CCl_4or APSPE],positive control group (Silymarin50 mg/kg), low-dose group (APSPE100 mg/kg), medium-dose group (APSPE200 mg/kg) and high-dose group (APSPE400 mg/kg).The mice received the appropriate nutrients intragastrically for ten days, the mice in all groups except control were injected intraperitoneally with CCl_4 .Twelve hours after CCl_4 injection, the mice were measured in terms of liver index, levels of alanine aminotransferase , aspartate aminotransferase in serum, as well as glutathione, superoxide dismutase, and malondialdehyde in liver homogenate[24].

ANTIMUTAGENIC AND ANTICARCIONOGENIC ACTIVITY

Salomonella typhimurium strain TA 98 and TA 100 and the SOS chromotest (umu test) to assess the antimutagenic potential of a methanolic extract from sweet potato (Ipomea batatas, IB) leaves. Investigating the role of gap junction in rat liver epithelial cells and calculating the IC50 on human cancer cell lines allowed researchers to further understand the anticarcinogenic effects. IB extract lowered considerably (p 0.01) the -galactosidase activities caused by mutagen 6-chloro-9-[3-(2-chloroethylamino)proylamino)-2-methoxyacridinedihydrochloride (ICR) at doses more than 0.4 mg/0.1 ml and inhibited dose-dependently the -galactosidase activity induced spontaneously at IB extract administration at concentrations greater than 40 g/ml significantly (p 0.01) enhanced the number of gap junctions[25].

CONCULSION:

Natural compounds from medicinal herbs have contributed significantly to the discovery of modern drugs and can be an alternative source for the discovery of novel structures with

better safety and efficacy profiles. Ethnobotanical and traditional uses of natural compounds, especially of plant origin received much attention in recent years as they are well tested for their efficacy and generally believed to be safe for human use. After an exhaustive review of the literature, *Ipomoea batatas* (L.) *lam* is widely recognized as a panacea in herbal medicine, having a wide range of pharmacological effects. These studies are extremely positive and suggest that further research on herb is necessary.

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