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Ipomoea Digitata-An Update

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Abstract

Ipomoea digitata is a very potential nutraceutical agent not completely explored. It belongs to family Convolvulaceae. Its phytochemical constituents make it a phytoestrogenic compound because of its similarities in activity with the oestrogen available in human body. The present update is the compilation of the research work conducted on the plant including the Standards, Phytochemistry and Pharmacological profiles. Preclinical Pharmacological study was performed on Spasmogenic effect, Revitalizing effect, Antioxidant activity, Antidiabetic activity, Hepatoprotective activity, Cardioprotective effect and Antihypertensive activity. Clinical trial studies including formulations designed on the plant.

Keywords
Ipomoea digitata, Vidarikanda.

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INTRODUCTION:

Ipomoea digitata popularly called Vidarikanda is the dried tuber belonging to family *Convoluaceae,* a large, perennial climber with tuberous roots, up to 60 cm long and 30 cm thick, even weighing up to 35 kg, from about 5 or 10 kg; they are distributed nearly throughout India.

SYNONYMS[1]:

Sanskrit : IkÀugandha, Vidar¢
Bengali : Shimiya, Shimiabatraji, Bhui Kumdo
English : Indian Kudju
Gujrati : Khakharvel, Vidaree, Vidareekand
Hindi: VidareeKand, Bilaikand, Sural, Patal Kand
Marathi : Bendriya bel, Bindree, Vendrichavel
Punjabi : Siali
Tamil : Nilpushni Kezhugu
Telugu : Nelagummudu[1]

DESCRIPTION[1]:

a) Macroscopic

Dried cut pieces of Ipomoea digitata tuber, 3 to 5 cm large, 2 to 4 cm broad and fibrous; outer surface where light brown in colour; on outer surface, where epidermis is present, is light brown with transverse warts and ridges; cut surface creamy; fleshy, transverse small warts and ridges are found on the surface, texture smooth; sweet in taste, no particular smell.

b) Microscopic

Transverse Section of whole root tuber is slightly wavy in outline, epidermis not discernible; 3 to 4 layers of cork cells, followed by 5 to7 layers of parenchymatous cells present; cork cambium-brown in colour and 2 or 3 cells thick, endodermis well developed; pericycle fibrous followed by 2 layers of stone cells filled with sandy crystals; phloem consist of sieve tubes, companion cells, patches of bast fibres and phloem parenchyma; xylem pentarch in young root, consist of vessels with

scalariform cross perforation, tracheids, xylem fibres and parenchyma; medullary rays broad and parenchymatous. The medullary rays and phloem cells are filled with starch grains which are polygonal, 2 to 5 µm in diameter, simple or two to many-compound, hilum is usually indistinct, occasionally a central cleft, lamellae indistinct. In macerated preparation crystal fibres are multicellular, articulated, each cell carrying a crystal of calcium oxalate; some of the articulated fibres are swollen in the middle like a bulb pipette.

Powder is Greyish-brown in color, there is no characteristic odour, it is bitter in taste; shows parenchyma filled with starch, septate fibres in the form of crystals fibres as well as shaped bulb like pipette; vessels with simple and scalariform cross perforation plates, stone cells, and starch as described under microscopy; powder treated with 1N NaOH in methanol and nitro-cellulose in amyl acetate gives light green fluorescence under UV 254 nm.

IDENTITY, PURITY AND STRENGTH[1]:

Foreign matter: Not more than 2 per cent,
Moisture content: Not more than 10 per cent,
Total ash: Not more than 11 per cent,
Acid insoluble ash: Not less than 1 per cent,
Alcohol soluble extractive: Not less than 13 per cent,
Water-soluble extractive: Not less than 22 per cent,
Starch: Not less than 14 per cent,

Thin layer chromatography (T.L.C.):

Thin layer chromatography (T.L.C.) of the methanolic extract on precoated silica gel 'G' plate (0.2 mm thick) using Toluene : Ethyl acetate : Methanol (80 : 20 : 0.5) shows under UV (366nm) blue fluorescent zones at Rf. 0.19, 0.25, 0.34, 0.38. On spraying with Anisaldehyde-sulphuric acid reagent and heating for ten minutes at 120oC, spots appear at Rf. 0.19 (green), 0.34 (Magenta), 0.45 (green), 0.48 (blue), 0.62 (blue), 0.67 (red) and 0.92 (dark pink).

CONSTITUENTS[1]:

Pterocarpan-tuberosin, pterocarpanone-hydroxytuberosone, two pterocarpenes-anhydrotuberosin and 3-O-methylanhydrotuberosin, and a coumestan tuberostan. An isoflavone-puerarone and a coumestan-puerarostan.

PROPERTIES AND ACTION[1]:

Rasa : Madhura
Guna : Guru, Snigdha
Virya: Acta
Vipaka: Madhura
DOSE - 3-6 g.

PHYTOCHEMICAL PROFILE:

The earliest studies on the Ipomoea digitata have shown that the fixed oil forming 1.3 per cent of the tubers of Ipomoea digitata Linn. Contains palmitic (8.15 per cent), oleic (60.10 per cent), linoleic (19.38 per cent), and linolenic acids (1.11 percent) in mixed acid fraction[2,17].

The alkaline hydrolysis of the ether-soluble resin glycoside (jalapin) fraction of the leaves and stems of Ipomoea digitata L. (Convolvulaceae) gave six organic acids, isobutyric, (*S*)-2-methylbutyric, tiglic, *n*-decanoic, *n*-dodecanoic, and cinnamic acids, and two glycosidic acids, quamoclinic acid A and operculinic acid A. Further, a new genuine resin glycoside, named digitatajalapin I, was isolated from the jalapin fraction, along with three known resin glycosides. Their structures have been determined on the basis of chemical and spectroscopic data[3].

The isolation and characterization of sitosterol, t-cinnamic acid [undecyl (E)-3-(4- hydroxyphenyl)-2-propenoate] was reported, an unknown coumarin and a lignan type resin glycoside from the tuberous roots of Ipomoea digitata. The structures of the compounds were elucidated on the basis of extensive chemical and spectroscopic data. Importantly, one of the compounds has exhibited significant antibacterial activity against Pseudomonas aeruginosa and E.coli. The resin glycosides og Ipomoea digitata are known as purgative ingredients and hence have medicinal value. The exact chemical and biological activity of the resin glycoside isolated is yet to be ascertained[4].

PHARMACOLOGICAL PROFILE:

Spasmogenic effect: A glycoside (paniculatin), with m.p. 134", CaoHs.rO13 has been isolated from the tubers of Ipomoea *digitata* Linn. It elevated the blood pressure, showed a stimulant effect on myocardium and respiration, a vasoconstrictor and bronchoconstrictor effect, a spasmogenic effect on smooth muscles of gut, and also an oxytocic activity. The LD_{50} (48 hr.), with 95 % fiducial limits, was found to be 867.4 (755.3-985.1) mg./kg. *(SE.*f1.03) intraperitoneally in mice[5].

Revitalizer: The Clinical efficacy and safety of a herbomineral drug containing Withania somnifera, Asparagus racemosus, Glyzzeriza glabra, Mucuna pruriens, Myristica fragrans, Anauchus pyrethrum, Ipomoea digitata, Sida cordifolia, Zinc ash complex and high energy carbohydrate molecules were evaluated in an open study. All the patents treated

with the drug reported good improvement in the various symptomatology of general weakness apatite, sleep mood and concentration the overall improvement ranged between 69-77% the drug was well tolerated[6].

Antioxidant activity: The plant extracts of 17 commonly used Indian medicinal plants including Ipomoea digitata were examined for their possible regulatory effect on nitric oxide (NO) levels using sodium nitroprusside as an NO donor *in vitro*. The study showed that the most of the plant extracts tested demonstrated direct scavenging of NO and exhibited significant activity. The potency of scavenging activity was in the following order: Alstonia scholaris > Cynodon dactylon > Morinda citrifolia > Tylophora indica > Tectona grandis > Aegle marmelos (leaf) > Momordica charantia > Phyllanthus niruri > Ocimum sanctum > Tinospora cordifolia (hexane extract) = Coleus ambonicus > Vitex negundo (alcoholic) > T. cordifolia (dichloromethane extract) > T. cordifolia (methanol extract) > *Ipomoea digitata* > V. negundo (aqueous) > Boerhaavia diffusa > Eugenia jambolana (seed) > T. cordifolia (aqueous extract) > V. negundo (dichloromethane/methanol extract) > Gingko biloba > Picrorrhiza kurroa > A. marmelos (fruit) > Santalum album > E. jambolana (leaf). All the extracts evaluated exhibited a dose-dependent NO scavenging activity. The A. scholaris bark showed its greatest NO scavenging effect of 81.86% at 250 mg/mL, as compared with G. biloba, where 54.9% scavenging was observed at a similar concentration[7].

In vitro antioxidant activity of methanol extract of tuberous root of *Ipomoea digitata* (Linn.) was investigated. The free radical scavenging activity to evaluate by Hydroxyl radical scavenging activity**,** FRAP method and Estimation of total phenol. Hydroxyl radical scavenging activity of methanolic extract and reference standard Ascorbate IC_{50} values was found to be 230 g/ml and 410 g/ml. FRAP method of methanolic extract and reference standard Ascorbate IC_{50} values was found to be 800 g/ml and 50 g/ml. The total phenol content of methanolic extract was found to be 7.51mg/g respectively[8].

Formulations: *Ipomoea digitata* Linn., is an annual extensive perennial climber with large ovoid and tuberous roots herb indigenous to India and widely used in the treatments of hypolipidemic, hypoglycaemic, for debility, to increase secretion of milk, to increases milk, poor digestion, tuberculosis, enlarged liver etc. It was also found to have alterative, aphrodisiac, cholagogue, demulcent, diuretic, rejuvenative actions. The formulation and evaluation of anti-diabetic activity of tablets which are prepared from aqueous extract of the selected plant. A solid pharmaceutical dosage formulation using a novel dry plant extract (tuberous roots) using various excipients viz., Carbopol, ethyl cellulose, MCC, dibasic calcium phosphate and PEG-4000 by direct compression was reported to be statically significant as anti-diabetic activity[9].

Lactovedic is a lactogenic polyherbal formulation containing Jivanti, Shatavari, Vidarikanda, Yashtimadhu and Shatapushpa and was processed with Swarasas of Bramhi, Mandukaparni, Matsyakashi, Shatavari and Kokilaksha. The aim of the study was to evaluate the galactogogue activity of the Lactovedic. Rats (175-200gms) suckling 8-9 pups were divided into 4 groups (n=6). Control group rats were treated with vehicle (2ml of 1% CMC sodium in normal saline) orally, group 2 and group 3 rats were orally administered 270 and 540mg/kg body weight, respectively of Lactovedic suspended in the vehicle, and group 4 animals were treated orally with 2.7mg/kg body weight of Domperidone suspended in vehicle from 3rd day of parturition to 15th day of parturition. Milk yield at 18hrs, the weight of pups at 18 and 23 hrs and the daily weight of the mother rat were estimated. On 16th day, blood samples were collected and mother rats were sacrificed. Glycogen and total protein content in mammary gland and serum prolactin and cortisol were estimated. Results were statistically analysed using analysis of variance (ANOVA), followed by Tukey-Kramer post Hoc test. Histopathology of mammary gland was performed. Lactovedic increases milk yield, pups body weight, weight of mother rat, glycogen and protein content of mammary gland tissue and serum prolactin and cortisol, compared to the control group, transverse section of mammary gland of Lactovedic treated rats showed proliferation of acini and marked increase in milk secretion in the ducts. It can be concluded that Lactovedic possess significant galactogogue activity[10].

Antidiabetic activity:

The antidiabetic effects of various fractions of *Ipomoea digitata* were studied on alloxan induced diabetic in rats. Root powder of the plant was extracted successively with alcohol and water; later the extracts were subjected for phytochemical screening to identify phytoconstituents. LD_{50} studies for both the extracts were conducted up to the dose level of 2 g/kg by following “Up and Down method of OECD Guidelines No. 425, 1/5, 1/10 and 1/20th doses from the maximum LD50 dose tested were selected for the study. Anti-diabetic activity was

studied in rats by using Low dose 100 mg/kg, medium dose 200 mg/kg, high dose 400 mg/kg of both the extracts. Anti-diabetic activity was studied against alloxan induced diabetes using Glibenclamide 10mg/kg body weight as a standard reference. Biochemical parameters (GLU, CHO, and TRG) were assessed in control/toxicant/standard and extract treated animals in the earlier mentioned models. During LD_{50} studies for both the extracts no mortality was observed in any animals up to the maximum dose level of 2000 mg/kg indicated their practically nontoxic nature. In Glibenclamide, AERID and AQERID treated groups when compared to alloxan toxicant groups the serum GLU, CHO, TRG levels were markedly decreased. The study was concluded with results demonstrating the antidiabetic potential of fractions of *Ipomoea digitata* and suggested that the plant may have therapeutic value in diabetes and related complications[11].

Effect on kidneys:

The kidneys provide the final common pathway for the excretion of many drugs and their metabolites and therefore are frequently subjected to high concentrations of potentially toxic substances. Administration of several antibiotics like *Gentamicin* causes kidney dysfunction. Rats treated with *Gentamicin* developed significant kidney dysfunction was observed from increased level of urea, creatinine, sodium and decreased level of protein, potassium and non-enzymatic antioxidants such as *vitamin C* and *vitamin E*. The plant, *Ipomoea digitata* is found to have nephroprotective activity[12].

Hepatoprotective:

Hepatoprotective activity hydroethanolic extract of tuberous root of *Ipomoea digitata* Linn. against CCl4 (i.p) induced liver damaged model in female Wister rat was studied. The extracted drug was subjected to preliminary phytochemical screening of extract and was even subjected to toxicity study. Hydroethanolic extract of tuberous root of *Ipomoea digitata* Linn. was administered orally at the dose of 250mg/kg and 500mg/kg. These shows significant protective effect on liver evidenced by lowering serum level of ALT, AST, ALKP, TB, DB, and Serum Triglyceride and also by histopathological study. Results were compared with standard (Silymarin) and control group. The study concluded that hydroethanolic extract of *Ipomoea digitata* Linn. shows significant hepatoprotective activity prevents chemically induced hepatic damaged in rat[13].

Cardioprotective effect:

The effect of the methanolic extract of tuberous root of Ipomoea digitata in reducing the cholesterol levels in experimentally induced hyperlipidaemic rats was studied. The parameters of the study were elevated levels of total cholesterol, ester & free cholesterol, phospholipids, triglycerides, low-density lipoprotein, and very low-density lipoprotein due to HFD. Administration of the methanolic extract of Ipomoea digitata (300mg/kg) was significantly ($P<0.001$) reduced the lipid profile and lipoprotein levels. Results showed a significant reduction in HDL-cholesterol was noticed in HFD fed groups (II); however, a significant increased the HDL level was produced by the administration of methanolic extract of Ipomoea digitata (dose 300mg/kg). There was a increase in the body weight in HFD fed group (II), which was reduced by the administration of methanolic extract of Ipomoea digitata (dose 300mg/kg). Therefore, it was concluded that the methanolic extract of tuberous root of Ipomoea digitata has definite cardio protective effect against hyperlipidemia[14].

Antihypertensive effect:

The tuber powder of Ipomoea digitata Linn. (Ksheervidari) was evaluated for the first time in a single blinded, placebo controlled study for its Antihypertensive potential and its effect on lipid profile, fibrinolytic activity and total antioxidant status in individual with stage 1 hypertension. Administration of 3gms tuber powder significantly ($p<0.001$) decreased systeolic, diastolic and mean blood pressure, increased fibrinolytic activity and total antioxidant status with a significant reduction ($p<0.05$) in serum total cholesterol, LDL cholesterol and atherogenic index at the end of twelve weeks. It was tolerated well without any significant side effect. In the placebo group, there were no significant alterations in any of the parameters at the end of the study[15].

Approximately 600-700 species of *Ipomoea*, Convolvulaceae, are found throughout tropical and subtropical regions of the world. Several of those species have been used as ornamental plants, food, medicines or in religious ritual. The present work reviews the traditional uses, chemistry and biological activities of *Ipomoea* species and illustrates the potential of the genus as a source of therapeutic agents. These species are used in different parts of the world for the treatment of several diseases, such as, diabetes, hypertension, dysentery, constipation, fatigue, arthritis, rheumatism, hydrocephaly, meningitis, kidney ailments and inflammations. Some of these species showed antimicrobial, analgesic, spasmolytic,

spasmogenic, hypoglycaemic, hypotensive, anticoagulant, anti-inflammatory, psychotomimetic and anticancer activities. Alkaloids, phenolics compounds and glycolipids are the most common biologically active constituents from these plant extracts[16].

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