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Review Article

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# Review on Brihati Dwaya

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**Keywords**

*Brihati, Kantakari, Brihatidwaya, Solanum indicum Linn, Solanum xanthocarpum* Schrad, Chemical composition, Morphology etc.

## Abstract

The *Brihatidwaya* comprises two drugs namely, *Brihati* and *Kantakari* belongs to family Solanaceae. The *Brihati* is *Solanum indicum* Linn /*Solanum nigrum* Linn whereas *Kantakari* is *Solanum surattense* Buurm f / *Solanum xanthocarpum* Schrad and Wendl). These both drugs are one of *Dashamula* an commonly used in *Ayurveda* for curing the many diseases. The whole plant including roots of these plants are used as antibacterial, anthalmentic, anti fungal, anti asthmatic, hypoglycemic, anti inflammatory, anti tumour, anti pyretic, anti spasmodic, anti histamic, hypotensive, cytotoxic activity. *Solanum xanthocarpum Solanum indicum* both are non-toxic and safe for human use and is regarded as a valuable plant in both Ayurvedic and modern drug development areas for its versatile medicinal uses. The present review aimed to document the potential aspects of these plants on the basis of scientific data from the electronic media. Further scientific evaluation will be carried out for the betterment of effective therapeutic compounds.

## Introduction

*Solanum xanthocarpum Solanum indicum* both are non-toxic and safe for human use and is regarded as a valuable plant in both Ayurvedic and modern drug development areas for its versatile medicinal uses. The plantsare widely studied and used for the various pharmacological activities like anti inflammatory antiasthmatic, antifungal, antibacterial, anthelmintic, hypoglycemic and mosquito repellent properties. Further studies of use of various analytical techniques for detection and isolation other phytochemical compounds and their therapeutic applications will possibly lead to journeying of new method for clinical application.

### Morphology of *Brihati*[1]-

It is branched, prickly shrub growing upto a height of 0.3-1.5 mts, Prickles are sharp, often slightly re curved, short hooked, and have a broad compressed base. The stem is stout and the branches are covered with minute stellate brown

hair. Leaves are ovate in outline, sparsely prickly on both sides and measure about 5-15 cms and 2.5 -7.5 cm wide. They are clothed above with simple hair and have bublous base intermixed with small stellate ones, while small stellate hair cover them on the lower surface. Petioles are prickly and about 1.3 to 2.5 cms long. The flowers occure in racemose, extra axillary cymes. Pedicels are 6-13 mm long, stellate hair and triangular teeth. Corolla is about 8mm long, pale, purple, clothed outside with darker, purple, stellate hair, lobes are 5mm long, deltoid, ovate, and acute. The fruit is a globose berry, green with white lining when young nd becomes yellow when ripe. Sometimes it has few stellate hair at the apex. Seeds are small, many, and discoid. Flowering occurs in September to October, while fruits begin to appear in October.

## Chemical composition of *Brihati*[2]-

The leaves and roots contain the steroidal alkaloids, solanine, solanidine and solasodine. The seed oil contains glycerides of lauric, palmitic, stearic, acachidic, oleic, linoleic acids together with phytosterols. Sitosterols and carpesterol. The fruit contains carbohydrates which hydrolyze into maltose, melibiose, sucrose, rafinose, steroidal alkaloids, enzymes and is a source material for cortisone and sex hormone preparations.

## Morphology of *Kantakari*[3]-

The branches are spreading on the ground. The plant is very prickly diffused bright green perennial herb, somewhat woody at the base. Branches are numerous, the younger ones clothed with dense stellate tomentum, prickles compressed, straight, yellow, glabrous, shining often exceeding and 1.3 cm long. The leaves are 5-10X2.5-5.7 cm ovate or elliptic, bearing stellate hair on both sides, sometimes becoming nearly glabrous with age. Petioles are 1.3 -2.5 cm long.

The flowers are axillary but some flowers are cymes and bluish-violet in colour. Pedicels are short, curved with stellate hairy. Calyx is nearly 1.3 cm long, denslely hairy and prickly, tube short, globose. Lobes 11 mm long, linear-lanceolate, acute and prickly outside.Corolla is purple, 2cm long, lobes deltoid, acute, hairy outside. Filament is 1.5 mm long, glabrous, anthers 8 mm long, oblong lanceolate and opening by small pores. Overy os ovoid, glabrous and style glabrous. Fruits are berry, 1.3-2 cms in diameter, yellow, or white with green veins and surrounded by the enlarged calyx. The seeds are 0.25cm in diameter, glabrous, smooth, sub reniform and yellowish brown.

## Chemical composition of the *Kantakari*[4]-

Carpesterol, gluco-alkaloid solanocarpine; solanine-S; solasodine, - solamargine, cycloartanol, cycloartenol, stigmasterol, campesterol, cholesterol, sitosteryl-glucoside, stigmasteryl- - sitesterol, methyl ester of 3,4-dihydroxycinnamic acid.

It contains B-Carotene, Diosgenin, Sitosterol, Carpesterol, Solasodine,Solamargine, B-Solamargine, Solasonine, Solasodino-L-Rhamnosy-B-D-Glucoside (Solasurine), Solanocarpidine, Solanocarpine (Solanine-S), Tomatidienol, fatty acid, isochlorogenic acid, neochronogenic acid, chronogenic acid, caffeic acid, quercetin, apigenin, histamine and acetylcholine.

## Identity, Purity and Strength[5]-

**Foreign matter -** Not more than 2 per cent.

**Total Ash-** Not more than 9 per cent.

**Acid-insoluble ash -** Not more than 3 per cent.

**Alcohol-soluble extractive-** Not less than 6 per cent

**Water-soluble extractive-** Not less than 16 per cent.

## *Ganas*- (*Brihati* and *Kantakari*)

**According to *Acharya Charaka*[6]-** *Kanthya, Hikkanigrahana, Shothahara, Angamarda Prashamana Ganas.*

**According to *Acharya Sushruta*-***Brihatyadi Gana*[7], *Laghu Panchamoola***

**According to *Acharya Vagbhata*-** *Laghu Panchamula*[8]-

**According to *Dhanwantari Nighantu*[9]-**

**According to *Raja Nighantu*[10]-**

**According to *Kayadeva Nighantu*[11]-**

**According to *Chandra Nighantu*[12]-**

**According to *Madanapala Nighantu*[13]-**

**According to *Bhavprakash Nighantu*[14]-**

**According to *Priya Nighantu*[15]-**

**Synonyms of *Brihati*[16]-** *Mahatikranta, Sinhikakuli, Bhantaki, Mahotika, Bahupatri, Kantakatanu, Kantalu, Katphalla, Dorali, Vrintaki, Sinhika, Kanta, Vartaki, Rashtrika, Kuli, Vishada, Sthulakantaki, Mahati, Mahotika, Shetamahotika, Shetabrihati, Sheatasinhi, Shwetaphala, Shwetavartakini, Swetabrihati.*

**Synonyms of *Kantakari*[17]-** *Dushparsha, Kshudra, Vyaghri, Nidigdhika, Kantalika, Kantakini, Dhavani, Dushpragharshini, Kshudrakanta, Kantarika, Chitraphala, Sitakantakarika, Shweta, Kshetradooti, Lakshmana, Sitasinhi, Sitakshudra, Kshudravartakini, Sita, Klinna, Katuvartaki, Kshetraja, Kapateshwari, Nisnehaphala, Raama, Sitakanta, Mahaushadhi, Gardabhi, Chandrika, Chandri, Chadrapushpa, Piyankari, Nakuli, Durlabha, Rasna.*

***Rasa panchaka* of *Brihati* and *Kantakari*[18]-**

***Rasa***- *Katu, Tikta*
***Guna***- *Laghu Ruksha, Teekshna*
***Virya***- *Ushna Virya*
***Vipaka***- *Katu Vipaka*

**Pharmacological actions of *Brihati* as per Ayurveda[18]-**

***Dosha Karma***- Because of *Ushna Virya* it subside *Kapha* and *Vata Dohas*. It is recommended in *Kapha Vataja Vikara.*

***Sansthanika Karma- Bahya*-(External)**- *Brihati* is *Vedanasthapana* (Alleviate pain), *Raktashodhaka* (Blood purifier), and *Shothahara* (Anti inflammatory), *Keshya* (Hair tonic), *Uttejaka* (Stimulant), and is indicated in *Vedana* (Pain), *Raktavikara* (Blood disorders). The *Brihati phala*, *Haridra*, and *Daruharidra* are mixed together *Dhupana* (Fumigation) is given in Yonikandu. In case of erectile dysfunction the seeds powder is applied. In case of *Indralupta* (Alopecia areata) its juice is applied.

***Abhyantara Sansthana*- Internal Administration**- As it is *Ushna* (Hot in potency) Virya it acts as *Dipana* (Appetizer), *Pachana* (Digestive), *Grahi* (Absorbent), *Krimighna* (Wormicidal/Germicidal). It is indicated in *Agnimandya* (Anorexia), *Grahanai* (Sprue syndrome), *Udarashoola* (Pain abdomen), *Aruchi* (Loss of taste), *Krimiroga*. The juice of *Brihatiphala* mixed with ghee and honey alleviates *Vamana*(Vomiting).

***Raktavaha Sansthana* (Circulatory system)**- It is *Hridayottejaka* (Cardiac stimulant), *Raktashodhaka* (Blood purifier), *Shothahara* (Edema). Indicated in *Hridaya Daurbalya*, *Shotha* (Edema), *Rakta Vikara* (Blood disorders). The *Beeja* (Seed) powder snuff alleviates *Sanjna Nasha*.

***Shwasana Sansthana***- It is *Kaphaghna* (Subsides *Kapha Dosha*), *Kasahara*, *Shwasahara*. It is indicated in *Pratishyaya* (Running nose), *Kasa* (Cough), *Kasa* (Dyspnoea), *Swarabheda* (Hoarseness of voice).

***Mutravaha Snasthana* (Urinary systems)**- It is *Mutrala*, indicated in *Mutrakrichra, Ashmari* (Urinary calculi).

***Prajanana Sansthana* (Reproductive system)**- The seeds are *Garbhashaya Sankochakara* (Contracts the uterus), and *Vajikara* (Aphrodisiac). Its is recommended in *Rajorodha* (Dysmenorrhea), *Kasthaprasava* (Painful delivery), *Sutika Roga* (Menstrual disorders).

***Twacha* (Skin)**- It is *Kusthaghna* (Skin diseases), used in *Charmaroga* (Skin diseases).

***Tapakrama* (Temperature)**- It is *Jwaraghna*, indicated in all types of *Jwara* (Fever).

***Prayojya Anga*** (Part used)- *Moola* (Root), *Phala* (Fruit)

***Matra- Kwatha*** (Decoction)- 40-50ml, ***Choorna***- 3-6gms.

***Vishishtha Yoga*** (Formulations)- *Brihatyadi Kwatha, Dashamularistha, Vyaghri Haritaki, Chavanaprasha*

**Pharmacological actions of *Brihati* as per modern science[19]-**

**Antibacterial activity-** Ethanolic extract of leaves of *S. indicum* showed antibacterial activity against *Corynebacterium diptheriae*, Pseudomonas spp., and *Salmonella typhimurium* (Gavimath et al., 2012) *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli* (Srividya et al., 2009) where as chloroform extract, acetone extract and ethanol extract also showed anti bacterial activity against pseudomonas (Srividya et al., 2009). *S. indicum* fruits also possess antibacterial activity. Aqueous and ethanolic extracts extracts were found to be effective against *Listeria innocua, S. aureus, E. coli* and *P. aeruginosa* strains. The activity of ethanolic extract was found to be better than the aqueous extract (Kouadio et al., 2011). Aqueous fraction of the ethanolic extract of S. indicum berries has been reported for concentration dependent inhibitory effect on *P.aeruginosa, P. fluorescens* and *P. syringae* strains. Flavonoids, carotenoids and saponins were reported in the tested aqueous fraction (Kouadio et al., 2014).

**Antioxidant activity-** Methnolic extract of berries from *S. indicum* was investigated for its antioxidant activity using In vitro DPPH (1, 1-Diphenyl-2 -Picryl hydrazyl radical) radical scavenging method. The extract shows maximum inhibition (70.007 ± 0.841%) at 200 µg/mL concentration (Deb et al., 2013a). In another study IC50 values were calculated for the ethanolic and aqueous extracts of berries against DPPH Scavenging assay and β- carotene/linoleate model system. Ethanolic extract was found to be more effective (IC50 37.22 ± 1.3) in β - Carotene assay while aqueous extract was found to be more effective in DPPH assay (IC50 21.83 ± 0.84). This indicates that the fruit may act as good source of natural antioxidants (Hasan et al., 2013). Moreover, it has been reported that the antioxidant potential of fruit increases as ripening occurs when investigated in FRAP test and Folin-Ciocalteau assay. It was possibly due to increase in concentration of β-carotene in red berries by 60 and 20 folds with respect to green and yellow berries, respectively. Ascorbic acid level was found to be equal in green and yellow berries, while in red berries its concentration decreases. Total polyphenol content was not changes with ripening but caffeoylquinic acids, caffeic acid, flavonol glycosides and naringenin concentration increases at maturity, while p-coumaric acid and feruloylquinic acids level found to be constant at all ripening stages (N'Dri et al., 2010). In addition, ethanolic extract of S. indicum berries significantly inhibited the formation of peroxides in linoleic acid emulsion system in a dose-dependent manner (Bhuvaneswari et al., 2014). Aqueous as well as ethanolic extract of leaves of S. indicum also shows DPPH scavenging potential (Narayanaswamy and Balakrishnanet, 2011). 7.3.

**Anthelmintic activity-** Butanol and aqueous fractions of methanolic extract of *S. indicum* fruits were screened for **anthelminthic activity** using *Caenorhabditis elegans* bioassay. Percentage of dead nematodes was recorded after 24 h incubation. Fractions eluted from DEAE cellulose showed **anthelmintic activity** in four separate peaks based on *C. elegans* assay. Those peaks were eluted at 0.1, 0.28, 0.48 and 0.85 M NaCl.

Highest mean death percentages observed at each peak were 53, 59, 37 and 61 respectively compared to the negative control. It seems that SI fruit contains at least four different anthelmintic compounds (Senaratne et al., 2011). Crude methanolic extract of *S. indicum* berries (100 mg/mL) was found to paralyze the Indian earthworm (*Pheretima posthuma*) within 9. 16 ± 0.12 second while the helminth dies in 17.71 ± 0.21 second (Deb et al., 2013a).

**Antiplasmodial activity-** The antiplasmodial activity of ethanolic fruit extract was evaluated *In vitro* against the chloroquine-resistant FcB1 strain of *Plasmodium falciparum*. Cytotoxicity was determined on the human MRC-5 (IC50 >50g/mL) and the rat L-6 cell lines (IC50 >50g/mL).

Plant extracts, showed significant **antimalarial activity** (IC50 41.3±7.0 g/Ml) (Zirihi et al., 2005).

**Hepatoprotective activity-**Hepatoprotective role of *S. indicum* extract (200 mg/kg) was screened in CCl4 induced hepatotoxicity model in rats. Sharma et al. Liver markers such as Alanine amino transferase (ALT), aspartate amino transferase (AST), alkaline phosphatase (ALP), acid phosphatase (ACP) and lactate dehydrogenase (LDH) along with certain biochemical parameters like total protein, total bilirubin, total cholesterol, triglycerides and urea were estimated in rats. The plant extract significantly ameliorates the damage produced by CCl4 (Bhuvaneswari et al., 2014). Anticancer Number of Indiosides (A to E) isolated from *S. indicum* have dose-dependent inhibitory effect on proliferation of Bel7402 cells, and can induce cell apoptosis through mitochondria-dependent pathway (Ma et al., 2006.). Solavetivone-1, a component of *S. indicum* exhibited cytotoxicity to OVCAR-3 cells (Syu et al., 2001). The anticancer activities of *S. indicum* (whole plant) chloroform soluble and insoluble fractions of the ethanolic extract were determined by using in-vitro techniques and showed cytotoxicity on seven cancer cell lines: Colo-205 (colon), KB (nasopharynx), HeLa (uterine cervix), HA22T (hepatoma), Hep-2 (laryngeal epidermoid), GBM8401/TSGH (glioma) and H1477 (melanoma). The purified constituents, dioscin and methyl protodioscin showed more potent effects by DEA and MTT assay. Dioscin, methyl protoprosapogenin A of dioscin, methyl protodioscin and protodioscin also demonstrated cytotoxicity on cultured C6 glioma cells by PRE assay and methyl protoprosapogenin A of dioscin, methyl protodioscin and protodioscin showed a tumor inhibitory effect in vivo in C6 glioma cells. In addition, dioscin had an inhibitory effect on the DNA synthesis of C6 glioma cells at 10 micrograms/mL (Chiang et al., 1991). Moreover, methanolic fruit extract was also evaluated for anti-cancer activity using MTT (3-(4, 5-dimethylthiazolyl)-2, 5-diphenyltetrazolium bromide) cytotoxicity assay in various cancer cell lines like human nonsmall cell lung carcinoma (H1975), prostatecarcinoma (PC3and DU145), colorectal carcinoma (HCT116) and malignant melanoma (A375). It was found that the fruit extract possess maximum cytotoxicity in prostatecarcinoma cell line with an IC50 of 8.48 µg/ml and 11.18µg/ml in DU145 cells and PC-3 cells respectively. Whereas extract exhibited cytotoxicity with IC50 of 9. 03µg/ml, in H1975 cells. Similarly extract showed cytotoxicity with IC50 of 17.58µg/ml, in HCT116 cells and cytotoxicity with IC5027.94 µg/ml, in A375 cells (Gopalakrishna et al., 2014). In addition, fresh fruit of *S. indicum*, have also shown significant brine shrimp lethality and the LC50 values were found to be 4.42 ± 0.67 (µg/ml) (Rahman et al., 2008).Haemolysis assay *S. indicum*, extracts was investigated for its hemolysis activity in different concentration (0-128 µg/ml) using human erythrocytes. The extract does not show any visible hemolysis activity (Gopalakrishna et al., 2014).

Laxative Crude methanolic extract of *S. indicum* fruits has been evaluated for laxative in male wistar albino rats. The laxative activity was determined based on the weight of the faeces matter after 8 hour and 16 hours of drug treatment. Extract produced a significant laxative activity in a dose dependent. Fresh Fruits Steroidal saponins Indiosides A, Yahara et al.,

1996, El- Aasr et al., 2009 2. Steroidal saponins Indiosides B, Yahara et al., 1996 3. Steroidal saponins Indiosides C, Yahara et al., 1996, Steroidal saponins Indiosides D, Yahara et al., 1996, Steroidal saponins Indiosides E, Yahara et al., 1996, Steroidal glycoside Indiosides F, El-Aasr et al., 2009. Steroidal glycoside Protodioscin Yahara et al., 1996, El- Aasr et al., 2009 Steroidal glycoside Carpesterol Yahara et al., 1996 . Steroidal glycoside Isoanguivine Yahara et al., 1996, Yin et al. 2014, Steroidal glycoside Solanidine, Yahara et al., 1996, Yin et al. 2014, Steroidal glycoside Solasodine, Yahara et al., 1996, Yin et al. 2014; Rathore et al., 1978, Steroidal glycoside Solamargine, Yahara et al., 1996, Yin et al. 2014, Root Sesquiterpenoids Solavetivone, Syu et al. 2001 14. Sesquiterpenoids Solafuranone Syu et al. 2001. Hydroxycoumarins Scopoletin, Syu et al. 2001, Phenolic compounds N-p-trans-Coumaroyltyramine, Syu et al. 2001 17. Phenolic compounds N-Trans-Feruloyltyramine, Syu et al. 2001 18. Coumarins 7-Hydroxy-6,8-Dimethoxy-3- (40-Hydroxy-30-Methoxyphenyl)-Coumarin,Yin et al. 2014, Seed Coumarins Isofraxidin, Yin et al. 2014, Coumarins Fraxetin, Yin et al. 2014, Coumarinolignoids alkaloids Indicumine A, Yin et al. 2013. Coumarinolignoids alkaloids Indicumin B, Yin et al. 2013, Coumarinolignoids alkaloids Indicumin C, Yin et al. 2013, Coumarinolignoids alkaloids Indicumin D, Yin et al. 2013, Coumarins Indicumin E , Yin et al. 2014, Bicoumarins Arteminorin A(26) Yin et al. 2013, Coumarinolignoids alkaloids Cleosandrin, Yin et al. 2013 28. Biscoumarin 4, 4'-biisofraxidin, Yin et al. 2013, Saponin Saponins 1 Gu et al., 2004 Saponin Saponins 2 Gu et al., 2004. Seed Glycerides of the Oil Trilinolein Saran et al., 1942 32. Glycerides of the Oil Oleodilinolin Saran et al., 1942 Glycerides of the Oil Dioleolinolin Saran et al., 1942. Glycerides of the Oil Palmitodilinolin Saran et al., 1942, Glycerides of the Oil Stearodilinolin Saran et al., 1942, Glycerides of the Oil Arachidodilinolin Saran et al., 1942, Glycerides of the Oil Palmitooleolinolin Saran et al., 1942. Glycerides of the Oil Stearooleolinolin Saran et al., 1942. Glycerides of the Oil Arachidooleolinolin Saran et al., 1942. Glycerides of the Oil Palmitodiolein Saran et al., 1942. Glycerides of the Oil Stearodiolein Saran et al., 1942. Glycerides of the Oil Arachidiolein Saran et al., 1942. Whole Plant Fatty acid Palmitic acid Puntambekar et al., 1941 Fatty acid Stearic acid Puntambekar et al. 1941 Fatty acid Arachidic acid Puntambekar et al. 1941. Fatty acid Oleic acid Puntambekar et al. 1941. Fatty acid Linoleic acid Puntambekar et al. 1941. Fatty acid Lauric Acid. Saran et al., 1942. Miscellaneous Polysachharide Maltose. Puntambekar et al., 1941. Polysachharide Melibiose. Puntambekar et al., 1941. Polysachharide Sucrose, Puntambekar et al., 1941 Polysachharide Raffinose, Puntambekar et al., 1941 53. Triterpenes β-Sitosterol, Chiang et al., 1991; Rathore et al., 1978; Varshney et al., 1971 54. Triterpenes Daucosterol, Chiang et al., 1991; Rathore et al., 1978; Varshney et al., 1971, Triterpenes Diosgenin, Chiang et al., 1991; Varshney et al., 1971 56. Triterpenes Lanosterol, Chiang et al., 1991; Varshney et al., 1971 Sharma et al. / It was observed that after 8 hours of treatment, MeOH extract treated groups (250 and 500 mg/kg p.o.) exhibited higher feacal output (133.32±1.136, 149.01±1.835 mg). After 8- 16 hours test drug exhibited increase in faecal output at both the conc. (258.83±2.045, 293.66±2.219mg) (Deb et al., 2013b).

**Cardiotonic activity** Frog's (*Bufo melanostictus*) heart was used for investigating the cardiotonic activity of methnolic extract of the fruits of *S. indicum* (5 and 10 mg/mL). The extract was found to produce marked cardiotonic activity in dose dependant manner. MeOH extract at concentration of 5 mg/ml shows mild increase in the force of contraction but no significant change in the heart rate. At 10 mg/mL concentration extract shows significant increase in the force of contraction and slight increase in heart rate. The plant extract exhibits wide therapeutic index and does not show any kind of cardiac toxicity at higher doses tested up to 5 gm/mL (Deb et al., 2013b).

**Gastric Ulcers**- The anti-ulcerogenic effects of the methanolic extract of *S. indicum* var. *distichum* fruit has been investigated on aspirin and ethanol induced ulceration in rats. The extract

(750 mg/kg) not only protects gastric mucosa from damaging effect of aspirin as well as ethanol but also promotes healing of the ulcer. The effect was probably due to its antioxidant potential as shown by restoration of antioxidant biomarkers such as glutathione, SOD, GR, CAT and LPO (Abeer et al., 2013).

**CNS depressant activity** -The spontaneous locomotor activity of adult wistar albino rats was evaluated after the administration of methanolic extract of fruit. The extract (500 mg/kg) exhibited maximum locomotor inhibitory activity after 1 hr. CNS depressant activity of drug was found to be significantly better than the standard drug diazepam (0.5 mg/kg) (Deb et al., 2014). 7.12. Anti hypertensive activity Blood pressure lowering effects of a standardized ethanolic extract of the *S. indicum* ssp. distichum fruit (containing > 0.15% chlorogenic acids) was evaluated in both normotensive and hypertensive (N(W)-nitro-L-arginine methylester. The spontaneous locomotor activity of adult wistar albino rats was evaluated after the administration of methanolic extract of bited maximum loco motor inhibitory activity after 1 hr. CNS depressant activity of drug the standard drug of a standardized ethanolic fruit (containing > 0.15% chlorogenic acids) was evaluated in both normotensive arginine methylester (L-NAME treated rats. The 4 weeks treatment with extract (30 mg/kg) showed no hypotensive effect in normotensive rats. However it prevents the animal from development of hypertension after L-NAME administration (Bahgat 2008). (38) 1-9 rats. The 4 weeks treatment with extract (30-300 mg/kg) showed no hypotensive effect in normotensive rats. However it prevents the animal from development of L NAME administration (Bahgat et al)

**Pharmacological actions of *Kantakari* as per *Ayurveda*[20]-**

***Dosha Karma***- Because of *Ushna Virya* (Hot in potency) it acts as *Kapha Vata Shamaka*, hence recommended in *Kapha-Vataja* diseases.

**Sansthanika Karma- Bahya (External)-** It is Vedanasthapana, Shothahara, Krimighna. The seeds are used in the form of fumigation in Krimidanta, Dantashoola, Arsha, Peenasa.

***Nadi Sansthana* (Nervous system)-** As it is Teekshna and Ushna Virya and Vatahara the juice is instilled in nose in Apatantraka, Apasmara, and loss of consciousness. It is also recommended in *Angamarda* (Bodyache), *Sandhivata* (Osteo arthritis), and *Vata Vikaras*.

***Pachana Sansthana* (Digestive system)**- It is *Dipana* (Appetizer), *Pachana* (Digestive) and *Krimighna* (Ant helminthic), *Rechana* (Laxative) hence used in *Agnimandya* (Loss of appetite), *Aruchi*(Loss of taste), *Vibandha* (Constipation), *Udaragata Krimi* (Intestinal worms).

***Raktavaha Sansthana*(Circulatory system)**- It is *Rakta Shodhaka* (Acts as blood purifier) and *Shothahara* (Anti inflammatory), helps in *Raktabhara* (High blood pressure), *Raktavikara* (Blood diseases), and *Shotha* (Edema).

***Shwasana Santhana*(Respiratory system)**- The *Kantakari* is *Kaphaghna* (Subsides *Kapha Dosha*), *Kasahara* (Cough), *Kanthya* (Improves voice), *Hikkanigrahana*, *Shwasahara*. It is recommended in *Pratishyaya* (Running nose), *Kasa* (Cough), *Shwasa* (Dyspnoea), *Parshwashoola* (Pain), *Swarabheda* (Hoarseness of voice), *Hikka* (Hicough). It eliminates the histamine hence used in asthma and allergy.

***Mutravaha Sansthana* (Urinary system)**- It is *Mutrala* hence used in *Ashmari* (Urinary calculi), *Puyameha* (One of the urinary disorder), and *Mutrakrichra* (Dysuria).

***Prajanana Santhana* (Reproductive system)**- Its seeds are *Garbhashaya Sankochakara* (Uterine contractions), *Vajikara* (Aphrodisiac), white colour *Kantakari* is *Garbhasthapaka*. The seeds are used in *Rajorodha*, *Kasthaprasava* (Dysmenorrhea), *Klaibya* (Loss of libido and erectile dysfunction).

***Twacha* (Skin)**- As it is *Ushna Virya* acts as *Swedajanana* (Increases perspiration). It is used in skin diseases.

***Tapakrama* (Temperature)**- Because of *Tikta Rasa* it acts as *Jwaraghna* (Antipyretic). Hence used in fever.

**Part used**- *Pachanga*- all the five parts of plant viz; root, stem, flower, seeds, leaves.
***Matra* (Dosage)**- *Kwatha* (Decoction)- 40-50 ml

***Vishistha Yoga* (Formulation)**- *Nidigdhikadi Kwatha, Vyaghriharitaki, Kantakarai Ghrita, Vyaghri Taila, Chyavanaprasha.*

**Pharmacological actions of Kantakari as per modern science[21]-**

**Antifungal activity**- S. Gaherwal et al was repotred the antifungal activity of kantakari against the *Aspergillus niger* and *Candida albicans* was tested on the basis of Agar well diffusion method in PDA media and growth inhibition in PDB media with distil water and Hexanic extract of Solanum xanthocarpum leaf.

**Antiasthmatic properties:[22],[23],[24]-** Bronchial asthma is an inflammatory disorder of the airways characterized by various airway obstruction, airway eosinophilic inflammation and bronchial hyper responsiveness and is a global health problem that results from a complex interplay between genetic and environmental factors. Among several respiratory diseases affecting man, bronchial asthma is the most common disabling syndrome. Nearly 7–10% of the world population suffers from bronchial asthma. A pilot study on the clinical efficacy of *Solanum xanthocarpum* Schrad and Wendl and *Solanum trilobatum* in bronchial asthma were undertaken to prove the significant use of herbs in treatment of asthma. It is evaluated that the therapeutic effect of ethanolic extract of *Solanum xanthocarpum* Schrad & Wendl i.e. asthma relieving or antihistaminic, antiallergic property. Mast cell stabilization as compared to standard drug Disodium chromoglycate (DSCG). *Solanum xanthocarpum* is widely used by practitioners of the Siddha system of medicine in southern India to treat respiratory diseases. The powder of whole dried plant or a decoction is used for this purpose. Govindan et al. (1999) showed that treatment with *Solanum xanthocarpum* improved the pulmonary functions to a significant level in patients suffering from mild to moderate asthma. Subjective relief from asthmatic symptoms was reported by the patients an hour after administration of *Solanum xanthocarpum* powder. The effect lasted for about 6–8hrs. However, responses observed were apparently less when compared to that of deriphilline or salbutamol. A decrease in forced expiration volume and peak expiration flow rates are indicative of both large and small airway obstruction and muscle power. The dose of *Solanum xanthocarpum* Schrad & Wendl was well tolerated and no untoward effects were reported. It was suggested that relief from the symptoms of bronchial asthma produced by *Solanum xanthocarpum* Schrad and Wendl may be due to; a bronchodilator effect, reduction in the bronchial mucosal edema, reduction in the secretions within the airway lumen.

**Anti-Fertility activity[25],[26],[27]-** Solasodine, an alkaloid of *Solanum xanthocarpum* possesses antispermatogenic activity. In Dixit VP 1980 study, chronic administration of solasodine (20mg/kg each other day oral for 60 days) rendered male rats and dogs infertile. Mating test showed 87% infertility in rats, this returned to normal after 60 days cessation of drug feeding. Solasodine is well tolerated and inhibits spermatogenesis and Sperm motility. No significant change was noticed in the weight of testes and accessory sex organs. The RNA, protein, sialic acidand glycogen contents of the test were reduced significantly, serum proteins, triglycerides, Serum enzymes (GOT/GPT /Alkaline phosphatase) nonesterified fatty acids levels were in normal range. Solasodine is estrogen free but inhibits testosterone release from dispersed mouse Leydig cells (200 uM significantly inhibited unstimulated and LH stimulated release). Solasodine can be developed as male pill of plant origin.

**Hypoglycemic activity**[28],[29],[30]- The aqueous extract of *Solanum xanthocarpum* showed significant hypoglycemic effect in both normal and streptozotocin induced diabetic rats at dose of 100 and 200 mg/kg. The activity showed by aqueous extract was comparable to that of standard oral hypoglycemic agent glibenclamide. The experimental results indicated that it exhibited a potent blood glucose lowering property both in normal and streptozotocin induced diabetic rats. The LD50 of the extract was found to be high indicating high margin of safety.

**Anti-inflammation activity**[31],[32],[33],[34],[35]- Solasodine isolated from Solanum trilobatum has been examined for anti-inflammatory activity in acute and chronic inflammatory animal models. Solasodine exerted statistically significant and dose-dependent antiinflammatory activity in carrageenan-induced rat paw oedema. Topical application of solasodine significantly inhibited the ear inflammation induced by multiple applications of tetradecanoyl-phorbol 13-acetate. The alkaloid produced a significant increase in the reaction time in the hot plate test. LPS-stimulated macrophage as a model of inflammation was used to investigate the antiinflammatory effects of tomatidine and solasodine whereby it was found that tomatidine exhibited a more potent anti-inflammatory effect than solasodine in the tested concentration.

**Antifilarial effect**[36],[37]- Lalit Mohan et al. reported the larvicidal potential ofcrude extracts of *Solanum xanthocarpum* and suggested its suitability as an ecofriendly, effective larvicide in the management of mosquito populations and in limiting the outbreak of various vector borne epidemics.

**Anthelmintic activity**[38]- Gunaselvi.G.et al confirmed anthelmintic activity of fruity extract of *Solanum xanthocarpum* plant .water as well as ethanolic extraxt of *Solanum xanthocarpum* fruit were used for study.

**Antibacterial activity**[39],[40] -Methanolic as well as acetone leaf extracts of *Solanum xanthocarpum* were quite effective in inhibiting the growth of *Staphylococcus aureus* which is a serious human pathogen causing infections in wounds. Possible reasons for this antibacterial activity of *Solanum xanthocarpum* are presence of alkaloids, phenolics and flavanoids in its leaves.

## Conclusion

*Solanum xanthocarpum Solanum indicum* both are non-toxic and safe for human use and the plants are regarded as a valuable plant in both *Ayurvedic* and modern drug development areas for its versatile medicinal uses. The plantsare widely studied and used for the various pharmacological activities like anti inflammatory antiasthmatic, antifungal, antibacterial, anthelmintic, hypoglycemic and mosquito repellent properties. Further studies of use of various analytical techniques for detection and isolation other phytochemical compounds and their therapeutic applications like the fruits of *Kantakari* is *Garbhasthapaka* (Prevents the abortion) will possibly lead to journeying of new method for clinical application.

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