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Review Article

A REVIEW ON TOXICITY OF CALOTROPIS (*ARKA*) AND MANAGEMENT

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ABSTRACT

The herbal medicine occupies distinct position right from ancient period in Ayurveda. *Arka (Calotropis*) an important drug of Ayurvedic toxicology and therapeutics is known in India from ancient period since *Samhitakala*. There are two types of *Arka* mentioned in Ayurveda. *Sweata arka* (*Calotropis gigantea*) *and Rakta arka* (*Calotropis procera*). Among the two *Raktaarka* (*Calotropis procera*) is more toxic and is assumed even more poisonous than cobra venom. Both these plants belong to *Asclepiadaceae* family and closely resemble each other in chemical and physiological actions. It is included under *Bhedaniya* (*Vagbhata*) *Vamanopaga, Svedopaga* (*Caraka*)*, Arkadi, Adhobhagahara, gana* (*Susruta*) and also included under *Guduchyadi Osadhi varga*. Toxic principals are Uscharin, Calotoxin, Calactin, Calotropin, Calotropage. *Ksheera* (Milk) being an irritant, neurotoxic and also due to anticholinergic responses cause toxicity and various fatal presentation. Serum containing 3% of Gigantin is highly virulent CSF toxicant. Toxic symptoms are *Vanti* (vomiting)*, Rechana* (diarrhoea) on ingestion. It exerts caustic (*Kshara*) effect to the skin on direct contact. It can lead to blindness if its latex is put in to the eyes, causing opacity to the cornea. Ghee is considered to be an antidote for internal usage and external application of *Cincha patra kalka*. The dried latex and dried root are used as an antidote for snake poisoning in Bagata tribe of Eastern Ghats of Visakhapatnam district, Andhra Pradesh. A detailed account of toxic effect of *Arka* and its descriptions in Ayurveda along with its management have been emphasized in the present review with toxic symptoms, management, medico legal cases and case reports.

Key words: *Arka*, Antidote *Gritha*, *Shveta Arka, Rakta Arka*, Toxicity, Antidote, Snake bite.

INTRODUCTION

Arka is one of the *Upavisa* an important drug of Ayurveda known since Vedic period. There are two common species of *Calotropis, viz Calotropis gigantea* (L.) Dry land and *C. procera* (Aiton) Dry land described in the classical literature of *Ayurveda* by the name of *Shveta Arka* and *Rakta Arka* respectively. *Calotropis* is a genus of plants that produce milky sap hence also commonly called milkweed. The latex of *Calotropis procera* is said to have mercury like effects on the human body, and is sometimes referred to as vegetable mercury and is used in place of mercury in aphrodisiacs. C. *Procera* is used variously but sometimes leaves are fried in oil for medicinal purposes. Cattle often stay away from both the plant *C. procera* and *C. Gigantea* because of their unpleasant taste and due to presence of Cardiac Glycosides in its sap. Root bark of C. *Procera* has Digitalis like effect on the heart, but was earlier used as a substitute of Ipecacuanha. It is a poisonous plant in which calotropin is a compound in the latex, is more toxic than strychnine[1].

The *Calotropis* Shrub that produces white or sometimes violet flowers are called as *Swetarka*. This is a rare shrub. Flowers of *Swetarka* are considered to be favourite of Lord Shiva. *C. Gigantea* as indicated by its name it is much larger and coarse plant than *C. procera*. Hindus obtain Ganapati from the root of *C. Gigantea* that sometimes takes the shape of Lord Ganesh. The root of C. *Gigantea* shrub is invited on some auspicious day (in the Ravi- Pushya Nakshatra) and carved into the form of Ganapati

or Ganesh in some auspicious *Muhurta*. Hindus believe that those who worship this idol of Ganesh enjoy the presence of Mahadevi Laxmi and Lord Shiva. Most recently *C. Gigantea* is scientifically reported for several medicinal properties viz. the flowers are reported to possess analgesic activity, antimicrobial and cytotoxic activity. Leaves and aerial parts of the plant are reported for anti-diarrhoeal activity, anti-Candida activity and antibacterial activity, antioxidant activity. Roots are reported to contain anti-pyretic activity, cytotoxic activity. Although both varieties of *Arka* have almost similar properties yet *C. Procera* is having comparatively more medicinal properties. *Calotropis procera*– smaller red flowers - (Chief source of *Raktaarka i*n N. India). *Calotropis gigantea* (red variety) – larger red flowers – (Chief source of *Raktaarka* in S. India) (Bodhi Nighantu, 2010)[1].

Acharya Caraka, mentioned *Arka* under *Virechanopaga gana*[2]. *Susruta Acharya* mentioned in *Arkadi, Adhobhagahara gana*[3]. *Acharya Vagbhata* considered under *Bhedaniya gana*[4]. According to *Bhavaprakasa Nighantu,* it is included under *Guducyadi varga*[5] and according to *Kaiyadeva Nighantu*, it is *Osadhi varga*[6].

Synonyms of *Shwetaarka* are *Ganrupa, Mandar, Vasukh, Shvetapushpa, Sadapushpa, Alarka*, *Partapsh* and *Rakta arka are Arkaparna, Vikran, Raktapushpa, Sukhalphal, Ashphot*. All synonyms of Sun belong to *Arka*, because it has *tikshnata* like that of Sun. Due to its poisonous activities it is called as Darkhatae Jahnak[1].

Sources of *Arka*

Rakta arka mainly has two sources. *Calotropis procera*– smaller red flowers - (Chief source *of Rakta arka* in N. India) and *Calotropis procera* (red variety) – larger red flowers – (Chief source of *Rakta arka* in S. India) (Bodhi Nighantu, 2010)

Shweta arka– mainly has only one source *Calotropis gigantea* (White variety) – larger White flowers – (Chief source of *Shwetaarka* all over the country). (Bodhi Nighantu, 2010). Most of the *Nighantus* (Ayurvedic Materia medica) have mentioned same properties of both *Arka* (Sharma Ramprasad, 1990). Dalhana in commentary of Susruta Samhita mentioned that, by *Arka* is considered only as *Rakta Arka*. *Rakta Arka* is having more *Tikshnata* (having more sharp in properties) compared to *Shveta Arka* (Vyas Shiv Kumar, 1986)[1].

Properties of both *Arka* according to Bhavprakash (Chunekar K.C., 2007) *Shveta Arka Pushpa-Vrishya* (potent)*, Laghu* (Light), *Dipana* (Appetizer*), Pachna* (Digestive), *Aruchi, Prasek* (controls excessive salivation*), Svasa Kasa hara* (cures asthma and cough) *Rakta Arka*: *Madhura Tikta, Krimi* (removes worms) *Kushta* (cures all type skin disease) *Kapha hara arsha* (piles), *Visha* (poison), *Raktapitta* (haemophilia), *Gulma, Sopha hara* (removes inflammation)[1].

Toxicity of *Calotropis procera*

Among the two, *Calotropis procera* is more toxic and is assumed even more poisonous than cobra venom. Both these plants belong to *Asclepiadaceae* family and closely resembles each other in chemical and physiological actions[7]. Toxic parts are leaves, stem, roots. Among these stem (latex) and roots are more poisonous. The root, especially of *Calotropis procera*, is a powerful poison. The cobra and other poisonous snakes, which cannot even withstand its smell. Hence, it is always carried by the snake charmers of Bengal to control or tame unruly cobras[7]. In the leaves, *Mudarine* is the principal active constituent as well as a bitter yellow acid, resin and 3 toxic glycosides calotropin, uscharin and calotoxin. The latex contains a powerful bacteriolytic enzyme, a very toxic glycoside calactin (the concentration of which is increased following insect or grasshopper attack as a defense mechanism) [8].Toxic principals are Uscharin, Calotoxin, Calactin, Calotropin, Calotropage.[7] Milk being an irritant, neurotoxic and also due to anticholinergic responses cause toxicity and various fatal presentation. Serum containing 3% of Gigantin is highly virulent toxicant[7].

When taken in large doses internally, *Madar* juice and latex gives rise to an acrid, bitter taste and a burning pain in mouth throat and stomach. These are followed by salivation, stomatitis, vomiting, diarrhoea, dilated pupils, tetanic convulsion, collapse and death. Sometimes delirium may occur. The fatal dose is not determined. The fatal period varies from half-an-hour to eight hours[9].

Toxic effect of *Arkaksheera* as per Ayurveda

By internal usage in large doses it causes (*Vanti*) vomiting and (*Rechana*) diarrhoea and external use it causes breaking of the skin. Due to its (*Kshara*) caustic effect, loss of sight occurs when enters the eyes. Therefore one must be careful while collecting this latex and see that it does not come in contact with the eyes[10].

In large doses, the leaf juice and latex produces toxic symptoms like burning in throat, irritation of stomach, nausea, vomiting, diarrhoea, tremors, vertigo, and convulsion[11].

Ayurvedic management

The leaves of the tamarind plant should be churned in water and if this application is rubbed over the body and the oral intake of the medicated water prepared with *Gairika* subsides all the poisonous effects of *Snuhi* and *Arka*[12]. The milk and ghee are recommended in the diet[11]. It should be triturate with *Sarsapa thaila* to remove toxicity[13]. It also mentioned that itself it get purified in sun light. Cow ghee is given as an antidote for internal use[14].

Management

General measures to be followed if attended within 2hrs of exposure. Gastric lavage followed with demulcent drink should be administered. Activated charcoal is administered. Morphine like drugs are used to control pain. Atropine Chloroform Amyle nitrate are antidote. Supportive and Symptomatic measures are followed. Maintain vital status, if necessary oxygen inhalation and IV fluids should be given. Epsolin inj. is given every 8hrs to combat convulsion[9].

Post-mortem appearance

Signs of irritation in the stomach and intestine may be seen. In the case of a woman, who died within one hour after *Madar* juice had been swallowed, the post-mortem examination showed discharge of blood from nostrils and mouth. The stomach was congested and contained about two ounces of chime like fluid. The small intestine was congested. The liver, spleen and kidneys were congested. The trachea was injected. The heart was empty. The brain and its membranes were congested[9].

Medico-legal points

The flowers, leaves, root –bark and milky juice of *Madar* plants are used in Indian medicine. The flowers have a digestive, stomachic and tonic action. The leaves are also an alternative and are used externally as a poultice over the abdomen in case of colic. The powdered root-bark in doses of 0.18 to 0.6g is used as an alternative, and in doses of 2 to 4g, as an emetic in place of *ipecacuanha*. The tincture prepared from it is used in dysentery. The milky juice is as a vesicant, as a depilatory and as a remedy for chronic skin affections[9].

Madar juice used by tanners for removing hair from skin. It also imparts a yellow colour to the skin and destroys the offensive odour of fresh leather. *Madar* juice is often used for procuring criminal abortion. It is either administered orally or introduced in to the uterus on an abortion stick. It is occasionally mixed with lead oxide[9].

Case reports

Madar juice is occasionally used for purposes of suicide, infanticide and homicide. A 17 years old married Muslim girl from *Basti*, who became pregnant because of an illicit intimacy with a neighbours boy, was given some abortive drug by the father to save the honour of the family. The girl died. The dead body later exhumed, and on autopsy, a three month old foetus was found in her uterus and on analysis, *Calotropis gigentia* was detected in her viscera[9].

A case has been reported where two pieces of sticks with some brownish sticky substance adhering at their ends were removed from the uterus of a female,32 years old, alleged to have died as a result of criminal abortion. The sticks were found to be *Madar*[9].

A case is also recorded where woman introduced into her uterus, pieces of cloth smeared with *Madar* juice, with view to stimulate an abortion in her sixth month of pregnancy. As she could not bear the pain caused by the insertion, she committed suicide by jumping in to well and on analysis, there is a presence of *Madar juice*[9].

Homicide

In the district of manbhum, a young woman was killed by the administration of *Madar* juice and her body was hanged with rope loosely tied round her neck. Autopsy finding was, a faint ligature mark around the neck; but, on the other hand, there were patches of inflammation in the mucous membrane of the stomach. The viscera, on analysis showed the presence of *Madar* juice[9].

Accidental poisoning

In annual report of the year1946, the chemical examiner of the united and the central provinces, describe the case of boy, aged 15, who was given a medicine containing *Madar* by a quack of Allahabad, and two hours later, he began to vomit and died. *Madar* was detected in viscera[9].

Used as cattle poison

A case occurred at Ghazipur, where a she goat, after returning from grazing, died in agony with convulsion. A cloth ball found in the rectum of the animal and the viscera removed from the body, revealed [9].

Ocular toxicity by latex of *Calotropis procera* (Sodom apple)

It was reported that a spectrum of ocular toxicity following accidental inoculation of latex of *Calotropis procera* (Sodom apple) in 29 eyes between January 2003 and December 2006. Reported in Indian J Ophthalmol[15].

Calotropis procera (Sodom apple) in 29 eyes between January 2003 and December 2006. All patients presented with sudden painless dimness of vision with photophobia, retrospective analysis of 29 patients were Right eye was affected in 25 (86%) cases. All eyes showed mild conjunctival congestion mild to moderate ciliary congestion.

All eyes had mild to severe corneal edema and Descemet's fold in a patient.

The latex of *Calotropis procera* contains several alkaloids (such as Calotropin, Catotoxin, Calcilin, Gigantin) which are caustic and considered poisonous in nature. In this series, all patients presented with sudden dimness of vision with photophobia due to corneal edema in Descemet's folds[15].

Tooth caries toxicity

A 35 years old lady reported to the department of oral and Maxilo facial surgery with the C/O pain, swelling and regurgitation of food and fluid from nose since 7 days. PH/O She had toothache in right upper posterior carious molar, thus she applied cotton pack wet with latex of the *Calotropis* which resulted in the burning of the mucosa, inflammation.

O/E there was slough on the palate with inflammation.

R/X Irrigation was done with normal saline.

Advised irrigation with warm saline gargle with povidon iodine solution. The antibiotic and anti-inflammatory. But not healed. End up in surgery[16].

Prativisha

Mentioned in *Charaka Cikitsasthana*, *Stavara visha* is an antidote for *Jangama visha* So, the dried latex and dried root are used as an antidote for snake poisoning[17].

Calotropis gigantea

Roots are crushed and aqueous extract is applied externally and some of it is also taken orally. Root bark is ground into paste and made into pills. These pills are given orally for thrice a day as an antidote and latex is applied on the bitten area. Leaves are ground along with the latex and made into small tablets and one pill is administered for every half an hour to act as an antidote. Root paste is applied locally in snakebite as anti venom[18].

Calotropis procera

Roots are ground along with pepper grains are administered orally. About 2-3 drops of root juice is swallowed. 5-6 drops of juice is applied on the bitten area also leaf latex is applied on the bitten area for every half an hour in a day. Plant latex is applied in snakebite for early cure. Latex of *Calotropis procera* and *Mangifera indica* mixed with Conc. HCl is applied locally [18].

DISCUSSION

The World Health Organization has estimated more than 80% of the world's population in developing countries depends primarily on herbal medicines for their basic healthcare needs. In recent years, traditional uses of natural compounds, especially those of plant origin, have received much attention of the world as they are well known for their efficacy and are generally believed to be safe. But due to its toxicity it causes adverse effect. *Calotropis procera* consumption are reported to cause blisters, lesions and eruptions when taken by patients for the treatment of joint pains and gastrointestinal problems caries tooth and ocular toxicity. The preparations of *Calotropis procera* need to be used under the supervision of a trained medical practitioner (Lewis Nelson, 2007). Latex of *C. Gigantea* causes irritation to mucosa. An unidentified allergen is found in the latex of *C. Gigantea.* The plant is toxic and is one of the few plant not eaten by grazing animals. Due to its toxicity, the latex extracted from the stem has traditionally been used to make poison arrows. The latex is highly toxic to human eyes and produces sudden painless dimness of vision with photophobia. It is widely available so, used in all forms of medico legal cases.

CONCLUSION

It is one among *Upavisa* and its poisoning has many adverse effects which even may be fatal. *Calotropis procera* is having vast usage both therapeutically as well as with poisonous effect depending on the mode of use and dose. Even an acute poison can become an excellent drug if it is properly administered. On the other hand even a drug, if not properly administered, becomes an

acute poison. In Ayurveda *Ghrita* is mentioned as antidote. It is having properties like *Vranaropan, Vishagna, Dahashamaka,* so it heals blisters, inflammation, congestion in external and internal usage. Leaves and latex of *Arka* are antidote for snake bite.

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