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AYURVEDIC LITERARY REVIEW ON METHODS OF PURIFICATION AND THERAPEUTIC POTENTIAL OF *KUPEELU* (*Strychnos nux-vomica L*)

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ABSTRACT

Strychnos nux-vomica L., a poisonous tree is being therapeutically used after proper purification in Ayurveda, an Indian system of medicine. Several methods of purification and various therapeutic indications are described in Ayurvedic literature without a database structure. Though it is considered as a highly toxic drug, purified form can be used therapeutically at appropriate dose. All parts of *S.nux-vomica* contain the toxic alkaloids, viz., strychnine and brucine, but seeds are extensively used therapeutically and hence purifications methods are described mainly for seeds. Research studies report that after proper purification as described in Ayurvedic literature, the quantity of poisonous alkaloids in *S.nux-vomica* reduced significantly. Many therapeutic indications of *S.nux-vomica* are also described in Ayurvedic literature; some of them are scientifically validated by recent experimental studies. This paper is a compiled review of methods of purification and therapeutic potential of *S.nux-vomica* in Ayurvedic literature which may provide as a database for researchers.

Keywords: *Strychnos nux-vomica* L, Ayurveda, strychnine, brucine, purification,

INTRODUCTION

Strychnos nux-vomica L. is a medium sized poisonous tree belonging to Loganaceae family which is found abundantly in India in deciduous forests [1]. It is a powerful poison in large doses, producing tetanic convulsions and eventually death. In comparatively lesser doses it may result in mental derangement [2]. It is listed under Schedule E of Drug and Cosmetic Act 1940[3]. It contains poisonous indole alkaloids strychnine (1.23% in seeds) and brucine (1.55% in seeds); iridoids including glycoside, loganin, loganic acid, chlorogenic acid and minor related alkaloids including α-colubrine, icajine, 3-methoxy icajine, proto strychnine, vomicine, novacine, N- oxy strychnine, pseudo- strychnine and iso strychnine[4]. Further, the mechanism of toxicity of *S.nux-vomica* is elucidated by H-NMR (Proton Nuclear Magnetic Resonance Spectroscopy) based metabonomics i.e. by inducing disruptions in glycolysis, lipid and ami-

no acid metabolism and causing toxic effects in liver and kidney tissues [5]. Even though poisonous, some of them are therapeutically useful compounds. Strychnine is a cardiovascular and respiratory stimulant and has relatively more powerful stimulant action on motor cells of central nervous system [2]. Brucine and Brucine N-oxide have analgesic and anti-inflammatory activity [6]. Modern pharmacological studies have shown that *S.nux-vomica* possess medicinal properties like analgesic, anti-inflammatory[7], anticonvulsant[8], anti-amnesic[9], antidiarrhoeal[10], immunomodulatory[11], anti-snake venom[12], hepatoprotective, anticholestatic [13], antidiabetic[14], antioxidant[15]and anti-cancer with antiangiogenic effects.[16]

In Ayurveda, an Indian system of medical practices, *S.nux-vomica* is classified under *upavisha varga* (group of poisonous plants), but it is used therapeutically after suitable detoxification by several procedures [17]. In Ayurvedic literature, it is known as *Kupeelu* or *Karaskara* and its properties are mentioned as *Katu Tikta Rasa* (In taste), *Katu Vipaka* (final metabolic product) and *Ushna Veerya* (hot potency) with *Ruksha* (dry), *Laghu* (light) and *Tiksna* (sharp) *Guna*[18]. In indigenous systems of medicine like Ayurveda, it is used as a tonic, stimulant and febrifuge and its preparations are prescribed in nervous disorders [2]. Although roots, wood, leaves, bark, fruit pulp, hard fruit shells and seeds of *S.nux-vomica* contains the toxic alkaloids, strychnine and brucine[2], seeds are extensively used for therapeutical purposes. Hence prime importance is given to seeds while describing methods of purification. Seeds are indicated in various ailments like rheumatic diseases, skin diseases, chronic ulcers and nervous system disorders[1] and is an important ingredient in many Ayurvedic pharmaceutical preparations.

Safety of medicines was a major concern in ancient period itself. There was a continuing search for safe and effective medicine from natural sources. Many detoxification procedures are mentioned in Ayurvedic literature known as '*Shodhana Karma'* to improve the safety and efficacy of the drug [17]. Since *S.nux-vomica* is mostly used by physicians in Kerala, South India, most of the books like '*Kriyakoumudi'*[19] describing detoxification procedures and therapeutic indications are in Malayalam language without English commentary. Literature review of researchers is very difficult in the absence of a database structure. Hence descriptions regarding the methods of purification and therapeutic potential of *S.nux-vomica* were retrieved from ancient Ayurvedic scriptures, recent text books of *Dravyagunavijnana*, *Rasasastra* and *Agadatantra*, research articles from Pubmed and Google scholar, systematically reviewed and critically analyzed. This paper is a compiled review of methods of purification and therapeutic potential of *Strychnos nux-vomica* in Ayurvedic literature which may provide as a database for researchers.

Figure1: *S.nux-vomica;* dried seeds

METHODS OF PURIFICATION

The detoxification or purification process of any toxic material used for medicinal purposes is termed as "*Śodhana*" in Ayurveda [20]. Methods of purification of *S.nux-vomica* is mainly described in the Ayurvedic treatises viz., *Rasatarangini, Kriya koumudi, Rasamritam, Yogaretnakara*, *Oushadhasasyangal, Vanoushadhi retnakara* and Ayurvedic Formulary of India (AFI: a legally valid Ayurvedic drug document).

All parts of *Strychnos nux-vomica* contain the toxic alkaloids, strychnine and brucine [2]. Hence all parts should be purified before internal administration. Seeds are extensively used therapeutically, hence prime importance was given to seeds in all text books. Purification methods include processing in specific media like cow's milk, urine, ghee, butter-

milk, leaf juice of *Eugenia jambolana*, Ginger juice, castor oil etc.

General method of purification in AFI

Seeds of *S.nux-vomica* are soaked in freshly collected cow's urine for seven days with changing urine daily. After seven days, seeds are washed well with water and are subjected to *Swedana* with cow's milk by *Dola-yantra* method (a special boiling procedure in which seeds are tied in muslin cloth, kept immersed and hanged in cow's milk in a mud vessel) for three hours. Then the seeds are fried in cow's ghee until it attains brownish red color. Then the outer coat of seeds are removed by scraping with knife, powdered and kept in air –tight glass container [21, 22].

Purification methods in *Rasatarangini*

- Seeds of *S.nux vomica* are soaked in *Kanji* (Acidic fermented medicated water) for three days. Then its outer coat is removed, dried under shade and powdered [17].
- Seeds of *S.nux vomica* are tied in a muslin cloth to prepare bolus and kept immersed and hanged in a mud vessel filled with cow's milk without touching the bottom of the vessel. Milk is boiled in mild fire for three hours (*Swedana* in *Dolayantra*). After boiling, outer coat is removed, dried and powdered [17].
- Seeds of *S.nux vomica* are fried in cow's ghee until it attains brownish red color, outer coat is removed, dried and powdered [17,18,23]

Purification methods in *kriyakoumnudi*

- Seeds of *S.nux vomica* are kept inside paddy, added water, boiled for three hours, removed outer coat and embryo, kept immersed in leaf juice of *Amaranthus* for three hours and boiled in decoction of *Strychnos potatorum* seeds[19]
- Seeds of *S.nux vomica* are kept in cow dung for three days. It is taken out on the fourth day, washed well, kept in cow's urine and boiled in cow's milk and finally ground[19]
- Seeds of *S.nux-vomica* are boiled in cow's milk and removed the outer coat and embryo, dried and powdered. Seeds purified by this method are used for preparation of *Karaskara ghritha* indicated in *Vata Roga* [19] (a wide spectrum of nervous system disorders).
- Seeds of *S.nux-vomica* are boiled in butter milk and removed the outer coat and embryo, dried and powdered. Seeds purified by this method are used for preparation of formulations indicated in *Vata rakta Roga*[19] (spectrum of arthritic diseases with autoimmune pathology).
- Seeds of *S.nux-vomica* are boiled in leaf juice of *Eugenia jambolana* for three hours. All parts of *S.nux-vomica* can be purified by this method [19].
- All the methods of purification of *Datura metel* can be adopted for *S.nux-vomica* [19].

Traditional procedures

- Seeds of *S.nux vomica* are powdered and boiled in cow's milk along with twice amount of water and reduced to quantity of milk. Seeds are filtered and repeat the procedure two times[24]
- Purification using *Ardraka swarasa* (freshly prepared ginger juice) as media; Seeds (100g) are soaked in 1 liter of Ginger juice for 20 days in china clay vessel. Every day the seeds are stirred well with a glass rod. On the twenty-first day, the seeds are taken out, washed with luke-warm water, the outer seed coat and embryo are removed, cotyledons are dried and pulverized and kept in air tight glass container[25]
- 100g of seeds of S.nux-vomica should be fried in 20 ml of *Eranda taila* (Castor oil) in mild temperature until the seeds become swollen and reddish yellow in color. Seed coats were removed and powdered[26,27]
- The seeds were kept immersed in the exudates scraped from the fresh leaves and stems of *Aloe vera* covered with a lid and kept aside for 15 days, with occasional stirring. On the last day the seeds were washed. The swollen seeds were again immersed in the juice of *Zingiber officinale* and kept in a cool place for 7 days. The seed coat and the embryo were removed

from the seeds. The cotyledons were finally powdered [8].

Research updates on Purificatory Prcedures

A number of toxicological and pharmacological studies have been investigated on the active phyto-chemicals of *S.nux-vomica* after purification. Different techniques have been used for the analysis and quantification of strychnine and brucine in raw and processed seeds. Anwar *et al.*, 2015 conducted comparative study on purification of *S.nux-vomica* by boiling in cow's milk and frying in ghee. The detoxification resulted in sharp decrease in content of toxic metabolites. The process by boiling in milk was found much effective but tedious as compared to frying method [28]. Seeds of *S.nux-vomica* were processed in castor oil by Mitra *et al*., 2012 where the strychnine and brucine contents in processed and unprocessed seed were estimated by HPTLC (High Performance Thin Layer Chromatography). Strychnine and brucine content in the processed seed reduced up to 67.40% and 46.58% respectively as compared to unprocessed seeds [26]. In another experiment, Mitra *et al.*, 2011 studied effect of *Shodhana* on *S.nux-vomica* with special reference to strychnine and brucine content use the media *Kanji* and Ginger juice. This study revealed that strychnine content was reduced by 39.25% and 67.82% respectively and brucine content was reduced by 17.60% and 40.06% in comparison to raw *S.nux-vomica* as determined by HPTLC and the toxic loganin glycoside is eliminated [25]. The preliminary phytochemical investigation also showed significant changes in the level of phytoconstituents in different methods of *Śodhana*. Mitra *et al*., 2012 also compared three purification methods using cow's urine, cow's milk and both. After the treatment, strychnine and brucine contents were determined by HPTLC. Maximum reduction in the alkaloids content was found when seeds were purified in cow urine (soaking for 7 days), followed by boiling in cow milk for 3 hours [29]. Mitra *et al*., 2012 also proved that *Kupeelu* seed powder is having significant anti-inflammatory activity and subjecting through purificatory procedures with *Kanji* did not affect its efficacy [30]. It has also been reported that *Śodhana* processes of *Kupeelu* enhances its hepatoprotective potency [31].

Kumar *et al*, 2009 conducted comparative study on four methods of purification of *S.nux-vomica* using *kanji*, cow's milk, combined use of cow's urine, milk and ghee and cow's ghee using HPTLC and LC-MS. And it was found that 2nd and 3rd method considerably reduced total alkaloid content. Among these two processed samples, total Alkaloid Content of Sample 2 showed development of some distinct new peaks with a different Rf/Rt, when compared with other samples. Also, both the samples were found to be relatively less toxic towards orally dosed albino mice [32]. Choi *et al.*, 2004 content of strychnine from *S.nux-vomica* seeds was analyzed and compared to processed seeds by the HPLC–ESI/MS (Electrospray mass spectrometry) method. Using this technique, levels as low as 1 ng of strychnine were detected. In contrast to conventional UV detectors, this method also made it possible to discriminate brucine. This study resulted in finding the content of strychnine in detoxified seeds to be one tenth of unprocessed Strychno nux-vomica seeds [33].

Katiyar *et al.*, 2010 studied the effect of detoxification on *S.nux-vomica* seeds by processing with aloe and ginger juices, by frying in cow ghee and by boiling in cow's milk. The ethanolic extracts of purified seeds showed anti-convulsant activity [8]. Detoxification of *S.nux-vomica* might be due to the chemical changes that causes the enhance N–oxidation and conversion of strychnine and brucine into less toxic derivatives such as isostrychnine, isobrucine, strychnine N–oxide, brucine N–oxide, and reduced level of loganic acid content of the seeds[34].

THERAPEUTIC ACTIVITY

Numerous external and internal therapeutic uses of *S.nux-vomica* were documented in Ayurvedic literature, but a few of them are using in clinical practice. Key therapeutic indications include neurological disorders like hemiplegia, facial palsy, infertility, loss of appetite, skin diseases, ulcer, diarrhea and sciatica[35].It is also described as a diuretic and appetizer, improves physical strength, combats rabies

infection, useful in *grahani*, *unmada, adhmana, ajeernam* and *swasam*. Purified *S.nux-vomica* seeds strengthen nervous system. It combats lead toxicity in the body. The powder of the seeds should not be used in acute paralysis where the muscles are rigid with loss of sensation [17]. Medicinally useful parts of *S.nux-vomica* are seeds, leaves, roots and stem bark [1]

External therapeutic indications of *S.nux-vomica*

- Root decoction is useful externally in inflammatory conditions of joints[36]
- Stem bark powder is externally applied along with coconut oil in skin diseases, ulcer and abscesses[37]
- Leaves are externally applied in ulcers[38]
- Leaves are externally applied in pain and inflammation of joints along with tender coconut husk juice[24]
- External application of leaves with *Curcuma longa* is indicated in abscess[36]
- External application of leaves with *Pongamia pinnata* is indicated in burns[36]

Internal therapeutic indications of *S.nux-vomica*

Roots

- Roots are used in skin diseases and *Siroroga*[1].
- Decoction of root bark is given thrice daily in cholera[37]

Stem

- Stem bark preparations are useful in poisoning[37]

Leaves

- Leaf decoction is useful in paralytic conditions[1]
- Tender leaves of are indicated for chewing in indigestion[36]

Seeds

Seeds are indicated in chronic rheumatic diseases, neurodegenerative diseases, urolithiasis, leucorrhoea, chronic abscesses and ulcers, anaemia, asthma, bronchitis, constipation, diabetes, intermittent and malarial fevers, insomnia, cardiopalmus[1]. Traditionally, external application (*Seka*) of milk boiled with *S.nux-vomica* seed is used in inflammation of joints. Pulp of ripe fruit is used in paralytic affections of paw and foot [1].

- *Vishuchika*: *Kupeelu*, *Navasara* and Asafetida are fried individually, mixed together and made into pills[39]
- Fever: Pill made with *S.nux-vomica* and *Piper nigrum* along with decoction of *Holarrhena antidysenterica*[39]
- Loss of appetite: Pills made with *Kupeelu, Navasara* and Asafetida are administered with lemon juice [39].
- Seed powder is indicated for three months continuously in rheumatic diseases with joint pain, edema and difficulty in movements[33]
- Seeds are used with milk and sugar for hoarseness of voice caused by excessive talking [20].
- Seeds are useful in Tobacco addiction induced blindness, nocturia in children, impotency caused by excess sexual intercourse and old age, dyspnea and morning sickness in pregnant women[20]

System wise action of *S.nux-vomica* seeds

- Central Nervous System: Analgesic and stimulant; Indicated in neuralgia, facial palsy, paralysis and insomnia.
- Digestive system: Appetiser and digestive; Indicated in gastritis, abdominal colic, loss of appetite, sprue, haemorrhoids and helminthiasis.
- Circulatory system: Cardiotonic and causes hypertension; Indicated in cardiomyopathy, pericarditis and pericardial effusion.
- Respiratory system: Antitussive; Indicated in pleuritis.
- Urinary system: Decreases renal insufficiency; Indicated in enuresis.
- Reproductive system: Aphrodisiac.
- Integumentary system: Alleviates skin diseases, pruritus and acts as antiperspirant[18]

Ayurvedic Therapeutic Formulations containing *S.nux-vomica* seeds

Most of the pharmaceutical preparations containing *S.nux-vomica* are used in the disorders of *vāta dosha* (mainly responsible for neurological disorders and pain). Some of them are *Karaskara ghritham*[40], *Agnitundi rasa, Navajivana rasa, Lekshmivilasa rasa, Sulnirmulana rasa, Supti vatari rasa, Sarameya vishahara yoga, Vishatinduka taila*[17], *Krimimudgara rasa, Mahavishagarbha taila, Ekangavira rasa* and *Vishatinduka vati*[35]

Therapeutic Dose: 60-125mg of purified drug (seeds) [35]

Research updates on Pharmacology

Pharmacologically *S.nux-vomica* has been validated for antimicrobial, anti-inflammatory, anti convulsant, antidiabetic, anti-snake venom, anti diarrhoeal, antiviral, hepatoprotective, immunomodulatory, anti- amnesic, and anticancerous effects.

S. nux vomica seed extracts showed maximum inhibition against the gram negative bacteria and less or no inhibition against the fungal organisms tested [41]. The methanol extract of *S. nux- vomica* seeds showed significant anti-inflammatory activity [7]. Katiyar *et al*., reported that ethanolic extracts of *S.nux-vomica* seeds reduced spontaneous motor activity and inhibited catalepsy. The seeds processed in milk exhibited marked inhibition of PTZ induced convulsions and maximal potential of hypnosis, and were the safest LD_{50} [8]. Hydroalcoholic and aqueous *S.nux-vomica* seed extracts, administered orally are effective in controlling diabetes [14]. The whole seed extract of *S. nux vomica* (in low doses) effectively neutralized Daboia russelii venom induced lethal, haemorrhage, defibrinogenating, PLA2 enzyme activity and Naja kaouthia venom induced lethal, cardiotoxic, neurotoxic and PLA2 enzyme activity[12].

The ethanolic extracts of purified seeds were subjected to spontaneous motor activity (SMA), pentobarbitone-induced hypnosis, PTZ induced convulsions, diazepam-assisted protection and morphine-induced catalepsy. All samples reduced SMA and inhibited catalepsy. The seeds processed in milk showed the lowest strychnine content in the cotyledons, exhibited marked inhibition of PTZ induced convulsions and maximal potentiation of hypnosis, and were the safest (LD50). It was inferred that *nux-vomica* after processing tends to suppress spontaneous movements, reduces initiative and interest in environment and there was some potentiation of hypnosis. The present investigation reports that there is a weak to moderate degree of CNS depressant activity that justifies the use of the processed drug clinically in various neurological disorders like Parkinson's disease and Trigeminal neuralgia for which satisfactory treatment is still awaited [8].

S.nux vomica root bark possesses Antidiarrhoeal activity [10]. Stem bark and leaves of *S.nux-vomica* were compared for antiviral activity. Stem bark showed higher flavonoid content, cytotoxicity, antiviral activity and ABTS scavenging activity compared with leaves [42]. Stem extract of *S.nux-vomica* showed immunomodulatory effect on induction of ovalbumin specific IgE antibody response in a murine model, as evaluated by passive cutaneous anaphylaxis (PCA) [11].

Loganin, an iridoid glycoside extracted from the fruit of *S.nux-vomica* showed significant hepatoprotective and anticholestatic activities in rat model [13]. Loganin in *S.nux-vomica* improves learning and memory impairments induced by Scopolamine in mice [9].

Recently, this plant has been extensively researched on for its anti-cancer potential. By the virtue of the alkaloids, viz., strychnine and brucine in nux-vomica, it has shown promising results as an anti-cancer agent. *In vivo* and *in vitro* studies indicate that the mode of action may be either due to inhibition of VEGF-induced cell proliferation or by decreasing VEGF and tumor necrosis factor-α and increasing IL-12 expression or by inhibition of the HIF-1 pathway[16].*S. nux-vomica* Root extract Induces Apoptosis in the Human Multiple Myeloma Cell Line—U266B1[43]. Brucine, an alkaloid from seeds of *S.nux-vomica* represses hepatocellular carcinoma cell migration and metastasis [44]**.** *S. nux vomica*

leaves showed potent cytotoxic activity against human epidermoid larynx carcinoma, breast carcinoma (MCF-7) and colon carcinoma cell lines. Moreover, the leaf extract presented antinociceptive, antipyretic and anti-inflammatory activities in animal models of writhing test, tail immersion test, hot plate test as well as Brewer's yeast induced fever and carrageenan-induced inflammation, respectively [45].These evidences validate the ancient claims of Ayurveda regarding the therapeutic potential of *Strychnos nux-vomica.*

CONCLUSION

Strychnos nux-vomica, a poisonous plant is being therapeutically using in Ayurvedic system of medicine after proper purification. Many purification modalities are described in Ayurvedic literature, most of them includes heating process with specific media. The exact mechanism of purification is yet to be revealed. However, previous reports suggest that normal level of principal alkaloids; strychnine and brucine in *S.nux-vomica* seeds declined significantly by heat treatment and the amounts of isostrychnine, isobrucine, strychnine N-oxide and brucine N-oxide were increased[4,34]. The toxic alkaloids present in *S.nux-vomica* seeds may be converted into therapeutically useful less toxic alkaloids. Besides some methods are specifically indicated for particular diseases to yield specific therapeutic activity such as seeds purified with buttermilk are indicated in *Vata rakta* and with cow's milk are indicated in *Vata roga* [19]. Therefore, it may be concluded that the purification methods brings about some phytochemical changes that in turn augments the pharmacological effect of the drug.

Although many therapeutic indications of *S.nux-vomica* are widely described in Ayurvedic literature, its clinical application is limited. Anti-inflammatory and immunomodulatory activities justifies the role of purified *S.nux-vomica* in arthritic diseases. Likewise, Anti-convulsant, anti-amnesic and analgesic activities substantiates its role in nervous system. Glycosides present in it may be the reason for its anti-inflammatory activity [46]. *In vivo* and *in vitro* studies suggest that *S.nux-vomica* possess anti-cancer effects by the virtue of its alkaloids [16]. The descriptions about therapeutic uses of *S.nux-vomica* in Ayurvedic literature are broad, ambiguous and are not applied clinically. This leads should be further assessed and validated for results in clinical trials.

REFERENCES

1. Warrier PK, Nambiar VPK, Ramankutty C. Indian Medicinal Plants: a compendium of 500species, 5th Vol. New Delhi: Orient longman publisher; 1996. 202-06p.
2. The Wealth of India: Raw materials, Volume10. New Delhi: Council of Scientific and Industrial Research; 2003. 63-66p.
3. Ministry of Health and Family Welfare (Department of Health). Drugs and Cosmetics act 1940 with Drugs and Cosmetics Rules, 1945. New Delhi: Ministry of Health and Family Welfare (Department of Health), Government of India; 2003. 317p.
4. Evans WC. Trees and Evans Pharmacognosy, 16thed. London: Saunders Elsevier Publishers; 2009. 399p.
5. Fan Y, Liu S, Chen X, Feng M, Song F, Gao X. Toxicological effects of Nux Vomica in rats urine and serum by means of clinical chemistry, histopathology and 1H NMR-based metabonomics approach. Journal of Ethnopharmacology. 2018 Jan; 210: 242-53.
6. Yin W, Wang TS, Yin FZ, Cai BC. Analgesic and anti-inflammatory properties of brucine and brucine N-oxide extracted from seeds of Strychnos nux-vomica. Journal of ethnopharmacology. 2003 Oct 31; 88 (2): 205-14.
7. Bhavya DK, Krishnamoorthy M. In Vitro Anti-inflammatory property and phytochemical content of methanol extract of Strychnos nux-vomica L (Seeds). Journal of Pharmacognosy and Phytochemistry. 2016 Sep 1;5 (5):162.
8. Katiyar C, Kumar A, Bhattacharya SK, Singh RS. Ayurvedic processed seeds of nux-vomica: neuropharmacological and chemical evaluation. Fitoterapia. 2010 Apr 30; 81 (3):190-5.

9. Kwon SH, Kim HC, Lee SY, Jang CG. Loganin improves learning and memory impairments induced by scopolamine in mice. European journal of pharmacology. 2009 Oct 1; 619 (1):44-9.
10. Shoba FG, Thomas M. Study of antidiarrhoeal activity of four medicinal plants in castor-oil induced diarrhoea. Journal of Ethnopharmacology. 2001 Jun 30; 76(1):73-6.
11. Duddukuri GR, Brahmam AN, Rao DN. Suppressive effect of Strychnos nux-vomica on induction of ovalbumin-specific IgE antibody response in mice. IJ Biochemistry & Biophysics. 2008 Oct; 45: 341-44.
12. Chatterjee I, Chakravarty AK, Gomes A. Antisnake venom activity of ethanolic seed extract of Strychnos nux vomica Linn. Indian Journal of Experimental Biology. 2004 May; 42:468-75.
13. Visen PK, Saraswat B, Raj K, Bhaduri AP, Dubey MP. Prevention of galactosamine-induced hepatic damage by the natural product loganin from the plant strychnos nux-vomica: studies on isolated hepatocytes and bile flow in rat. Phytotherapy Research. 1998 Sep 1; 12 (6):405-8.
14. Bhati R, Singh A, Saharan VA, Ram V, Bhandari A. Strychnos nux-vomica seeds: Pharmacognostical standardization, extraction, and antidiabetic activity. Journal of Ayurveda and integrative medicine. 2012 Apr; 3 (2):80.
15. Chitra V, Varma PV, Raju KA, Prakash KJ. Study of Antidiabetic and free radical scavenging activity of the seed extract of Strychnos nux-vomica. Int JPharm Pharm Sci 2010; 2(suppl 1):106-10.
16. Sah A, Khatik GL, Vyas M, Yadav P. A short review on antiancer investigations of Strychnos nux-vomica. Int J Green Pharm 2016; (suppl)Jul-Sep;10(3):87-90.
17. Sharma S. Rasatarangini: English commentary by Ravindra Angadi. Varanasi: Chaukhamba Surbharati Prakasan; 2015. 450-07p.
18. Sharma PV. Dravya Guna Vijnan, Volume 1I. Varanasi: Choukhambha Bharati Academi; 2005 .83p.
19. Menon VMK. Kriyakoumudi. Kerala:Sahitya Vravarthaka Cooperative Society Ltd; 1986. 858-59p.
20. Gogte VM. Ayurvedic Pharmacology and Therapeutic uses of medicinal plants, 1st edi. Mumbai: Bharatiya Vaidya Bhavan; 2000. 347p.
21. Ayurvedic Formulary of India: PART 1.New Delhi:Ministry of health and family welfare, Department of indian system of medicine and homeopathy, Government of india; 2000. 21p.
22. Trikamji Y. Rasamritam: English translation by Joshi D & Rao P, Varanasi: Choukhambha Sanskrit samsthan; 2007. 285p.
23. Mishra BS. Yogaratnakara. Varanasi: Choukambha Prakashana; 2010. 167-9p.
24. Nesamony S.Oushadhasasyangal, 10th edi.Trivandrum :Kerala Language institute; 2001.161p.
25. Mitra S, Shukla VJ, Acharya R. Effect of Shodhana(Processing) on Kupeelu(Strychnos nux- vomica Linn.) with special reference to strychnine and brucine content. Ayu 2011 Jul-Sep; 32(3):402-07.
26. Mitra S, Shukla VJ, Acharya R. Role of Castor oil in processing (Shodhana) of Kupeelu (Strychnos nux- vomica Linn.) seeds: An approach of Traditional Ayurveda. IJAM 2011;Vol 2(2).
27. Parikh GN. Vanousadhi Rathnakara. Vol. II. 2nd ed. Vijaygarh: Sudhanidhi Karyalaya; 1990. 370-2p.
28. Anwar N, Khan MS, Kabir H, Ahmad S. Effect of detoxification (tadbeer) in content of toxic metabolites of Strychnos nux-vomica: A Unani approach for its use in human. Journal of pharmacy & bioallied sciences. 2015 Oct; 7 (4):314.
29. Mitra S, Shukla VJ, Acharya R. Effect of purificatory measures through cow's urine and milk on strychnine and brucine content of *kupeelu (Strychnos nux-vomica* Linn.) seeds.Afr J Tradit Complement Altern Med. 2012; 9(1):105-11.
30. Mitra S, Kumar V, Ashok BK, Acharya RN, Ravishankar B. A comparative anti-inflammatory activity of raw and processed Kupeelu (Strychnos nux-vomica Linn.) seeds on

albino rats. Ancient science of life. 2011 Oct; 31 (2):73.
31. Gopalkrishna SV, Lakshmi Narasu M, Ramachandra SS. Hepatoprotective activity of detoxified seeds of nux vomica against CCl4 induced hepatic injury in albino rats. Pharmacologyonline. 2010; 1: 803-15.
32. Kumar A, Sinha BN. Ayurvedic processings of nux–vomica: Qualitative and quantitative determination of total alkaloidal contents and relative toxicity. Malays J Pharm Sci. 2009; 7:83-98.
33. Choi YH, Sohn YM, Kim CY, Oh KY, Kim J. Analysis of strychnine from detoxified Strychno nux-vomica seeds using liquid chromatography–electrospray mass spectrometry. Journal of ethnopharmacology. 2004 Jul 31; 93(1):109-12.
34. Cai B, Hattori M, Namba T. Changes iin alkaloid composition of the seeds of Strychnos nux vomica on Traditional Drug-processing. Chem. Pharm. Bull.1990;38(5): 1295-8.
35. Ayurvedic Pharmacopoeia of India: Volume 4. New Delhi: Ministry of health and family welfare, Department of indian system of medicine and homeopathy, Government of india; 2000. 158-60p.
36. Mehta V, Retnakaran C, Sankaran C. Keraleeya Oushadha Vijnanam: Oushadha Yogas from Thaliyola, Volume 1. Govt. of Kerala: Patent Cell, Directorate of Ayurveda Medical Education; 2009. 289p.
37. Tirumulpadu KR, Ayurveda Vinjanakosam, Samrat Publishers, Thrissur, 2004, 88p.
38. Bhavamisra. Bhavaprakasha nighantu (Indian materia medica): Commentary by Chunekar KC. Varanasi: Choukkhambha Bharat Academy; 2013,237p.
39. Sastry JLN. Dravyagunavijnana, Volume II.Varanasi: Choukhambha Orientalia; 2009. 352-54p.
40. Krishnan Vaidya KV, Gopalapillai SA. Sahasrayoga: Sujanapriya Commentary. Alappuzha: Vidyrambham Publishers; 2006. 325p.
41. Joy ALM, Appavoo MR. Antibacterial and antifungal activity of Strychnos nux vomica seed extract. Journal of Chemical and Pharmaceutical Research. 2015, 7(4):1495-99.
42. Enkhtaivan G, John KM, Ayyanar M, Sekar T, Jin KJ, Kim DH. Anti-influenza (H1N1) potential of leaf and stem bark extracts of selected medicinal plants of South India. Saudi journal of biological sciences. 2015 Sep 30; 22(5):532-8.
43. Rao PS, Prasad MN. Strychnos nux-vomica Root Extract Induces Apoptosis in the Human Multiple Myeloma Cell Line—U266B1. Cell biochemistry and biophysics. 2013 Jul 1; 66 (3):443-50.
44. Shu G, Mi X, Cai J, Zhang X, Yin W, Yang X, Li Y, Chen L, Deng X. Brucine, an alkaloid from seeds of Strychnos nux-vomica Linn., represses hepatocellular carcinoma cell migration and metastasis: the role of hypoxia inducible factor 1 pathway. Toxicology letters. 2013 Oct 24; 222(2):91-101.
45. Eldahshan OA, Abdel-Daim MM. Phytochemical study, cytotoxic, analgesic, antipyretic and anti-inflammatory activities of Strychnos nux-vomica. Cytotechnology. 2015 Oct 1; 67 (5):831-44.
46. Viljoen A, Mncwangi N, Vermaak I. Anti inflammatory iridoids of Botanical origin. Curr Med Chem.2012 May; 19(14):2104-27.

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