The arsenic and mercury-containing Tanjore pills used in treating snake bites in the 18th century Madras Presidency

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Information on animal venoms and plant and mineral-based poisons along with remedial procedures is available plentifully in ancient Indian texts, such as the *Atharva Véda*. As early as the 4th Century BC, poison therapists known as the Agandankarãs existed in India. *Arthasãstra* (2nd century AD?) includes references to protecting the King from being poisoned. *Sušruta Samhitã* and *Çaraka Samhitã* include hints on poisoning army animals and royal families[1]. Nearly 40,000 human fatalities occurred annually due to half a million snake bites until the early years of the 20th century[2]. Until the knowledge of using antivenom – based on immunological principles – came into effect, venomous snakes were a major threat to humanity. At this point, we need to remember the trailblazing work of the French physician–microbiologist Léon Charles Albert Calmette (1863–1933), a protégé of Louis Pasteur, on antivenins[3] with gratitude.

Johann Reinhold Forster (1729–1798) from Halle, Germany, asks his former student Christoph(er) Samuel John (1747–1813), a Lutheran missionary in Ŧanjavur (note 1), India, the following (ref. 4, p. 207):

> 'Is it not possible to find out the ingredients of the anti-poison against the bites of poisonous snakes? Are these anti-poisons always effective?'

John[5] responds:

> 'The previous servant of the missionary Schwarz (note 2), 'Samuel' had the recipe against the bite of the cobra (*Brillen Schlange*) and rabid dogs. In the presence of Schwarz, he [Samuel] cured many. Some of his cases attracted attention and brought him fame. Everyone purchased some pills from him each of which cost half a *fano* (note 3). They were black and big like a pea. He used to give all the instructions how to use them. He kept the recipe as a secret till the government in Madras requested Schwarz to send the man to Madras to reveal the secret, which would be useful for the people for which he would get a reward. This happened and I (C S John) met him three years ago when I was returning from Madras. He got 200 star-pagodas (note 4) for his invention. It was then made known in the *Madras Courier* (note 4).'

One Mr Strange (note 5) in Ŧanjavur petitioned to Archibald Campbell, the Governor of Madras, about a *vaidyan* (note 6), who was claiming that his 'pills' treat snake poisoning in 1788 (ref. 6). Mr Strange, along with Frederick Schwartz proposed to Campbell that this *vaidyan*'s medical skills and the veracity of his claim need verification. Campbell ordered that the *Ŧanjavur vaidyan* appears before the Madras-Hospital Board (MHB) with his pills, which was generically referred as the *Tanjore pills*. After relevant chemical analysis, the MHB approved and encouraged the use of Tanjore pills to treat not only snake bites, but also rabid-dog bites. MHB instructed the local medical suppliers to ensure an uninterrupted supply of these pills to Madras residents. MHB recommended that the composition of the pills along with details of administration and that the vernacular and English names of ingredients be advertised widely in the *Madras Courier*. William Duffin – a surgeon in Vellore (Madras Presidency) – along with a few other local Western medical practitioners wrote a rejoinder to MHB, relaying the message in September 1788 (ref. 7, pp. 238–241):

> '… although the results of tests were convincing, some of the materials included in the pills were to be reconsidered for a general recommendation for public use.'

They sought details of ingredients of these pills. James Anderson, Surgeon-General in Madras[8], submitted a report to the Government on these pills listing its ingredients in November 1788, indicating arsenic as a major component. Because of arsenic, Anderson did not recommend these pills for public use:

> 'Wishing as I do to expel for the sake of humanity such noxious drugs from our *Materia Medica*.'[6] (p. 20)

Duffin, now a Head Surgeon in the Madras Hospital challenged Anderson's decision (date unavailable). Duffin argued that despite arsenic, the pills were helpful to a majority of patients he treated, and that he had earlier transmitted his findings to Patrick Russell in 1791 (ref. 9), a physician to the English East-India Company, who, in turn, had transmitted details of these pills to London.

The Monthly Journal (*London*) in a notice on Patrick Russell's book, *An Account of Indian Serpents, Collected on the Coast of Coromandel: Containing Descriptions and Drawings of Each Species; Together with Experiments and Remarks on their Several Poisons* indicates (ref. 10, p. 73):

> 'The most celebrated remedy in India for the bite of a serpent is the Tanjore pill, the principal active ingredient is white arsenic; of which each pill, of six grains, contains about three-fourths of a grain. This was given to several dogs and chickens after having been bitten, but of these the greater number died; and in the few that recovered, the action of the medicine was so unequivocal as to destroy all confidence in it: the same may be said of the application of the actual cautery, and of alkaline and acid caustics. A few cases are given of the effects of the bite of serpents on the human species. The symptoms appear to have been very severe, and occasionally to have terminated fatally; in those that ended successfully, the Tanjore pill, Madeira wine, and *eau de Luce* (note 7), were administered separately or united, with seemingly good effects.'

The term 'celebrated' used in the above passage is confusing, since 'celebrated' was not a value term in the 18th century; it meant 'notorious', in addition to 'famous' (Dominik Wujastyk, personal commun., 13 January 2014).

Duncan and Duncan (ref. 11, pp. 9–17) in their 18-page notice of Russell's book (*op. cit.*) refer to these pills, alluding to different cases handled by William Duffin and one Captain Gowdie.

An obituary of Patrick Russell (ref. 12, p. 907) refers to his interest in these pills:

> 'It may not be improper to mention here, that about this time, the secret of a remedy long in use among the natives for the bite of venomous and rabid animals, and generally known by the name of the *Tanjore pill*, was purchased by the Madras government from a Brahmin. Besides arsenic and mercury, the medicine was found upon analysis to contain one or two unknown ingredients. Having purchased parcels of these last under the Malabar and Gentoo (note 8) names, Dr Russell himself made up a considerable quantity of these pills, carefully employing the prescribed proportions of each ingredient. … From Dr Russell's own experiences, as well as from some interesting communications by Mr Duffin, then surgeon at Vellore, it appears that this remedy often proved fallacious both in case of the bites of snakes and of mad dogs: still, however, Dr Russell, while he admitted its efficacy was a matter of difficult discussion, was inclined to think, favourably of it, and to encourage hopes that further experience might confirm its good character.'

Duffin argued that he conducted experiments with the pills to establish its use. Russell closed the debate in his 1796 book (*ibid.*) saying that his experiments using animal models to test the efficacy of these pills proved ineffective. Mathieu Joseph Bonaventure Orfila (1787–1853) in *A General System of Toxicology*[13], describes the seven trials carried out by Patrick Russell using dogs, rabbits, and fowl in detail (pp. 448–449). In a footnote Orfila remarks (p. 448):

> 'An Indian preparation, very much in vogue for the cure of the bite of venomous animals, Russell does not give its composition; but he says, that the white oxide of arsenic (arsenious acid) forms the base of it, and that a pill of six grains contains something less than three quarters of a grain of it.'

Although Russell's assertion of these pills – positive earlier and negative later – in his 1796 book (*ibid.*) ended his involvement with these controversial pills, references to these pills figured in Western Pharmacœopiae (e.g. Parr[14], p. 580) as a 'potent' remedy to snake and rabid-dog bites, and even to other illnesses as well. Indeed it evoked interest in the Western medical circles, decades later. For instance, Gray[15] refers to these pills in 1856:

> 'East India Pills, *Tanjore Pills*: Arsen. alb. ʒ *j*, pip. nigri. ʒ *vj*, mix: used in confirmed lues (note 9), as a preventive of canine madness, and in elephantiasis (note 9).'

Composition, preparation, administration and patient management

Hooper (ref. 16, p. 36) provides the composition of the Tanjore pills:

> 'Take of White arsenic, roots of vellinavi, roots of neri-visham, kernals of nervalam, pepper, and quicksilver; of each an equal quantity,'

by referring to these pills as 'the Carnatic snake pills'. The 'white arsenic' is the oxide of arsenic (As_2O_3), 'quicksilver' is mercury (Hg), 'pepper' (black pepper) is *Piper nigrum* (Piperaceae), '*nervalam*' (nirvãlam) is *Croton tiglium* (Euphorbiaceae), '*vellinavi*' (which should be read as *vellai-navi*) is *Aconitum ferox* (Ranunculaceae), and *neri-visham* (read as *nari-visham*, *nari-vidam*) is *Limonia acidissima* (= *Feronia elephantum*) (Rutaceae).

Chevalier (ref. 17, pp. 400–401) describes the method of preparation of these pills:

> 'The quicksilver is to be rubbed with *juice of wild cotton* [italics are ours; read these terms as 'the latex of *Calotropis gigantea*, Asclepiadaceae'] till the globules became invisible (note 10). The arsenic, being first levigated, and the other ingredients reduced to a powder, are then to be added, and the whole beaten up together with the juice of the wild cotton to a consistence fit to be divided into pills of six grains (note 11) each. Each pill, therefore, contains nearly one grain of arsenic, which is given in the state of white oxyd ['oxide'].

Details on the administration are available in Hooper (ref. 16, p. 36):

> 'Dr Russell (*sic.* Patrick Russell) gives the following directions for using these pills: if a person be bitten by a cobra-de-capello (Indian cobra; *Naja naja*), mix one of the pills with a little warm water, and give it to the patient. After waiting a quarter of an hour, should the symptoms of infection increase, give two pills more; should these not sufficiently counteract the poison, another pill must be given an hour after. This is generally found sufficient. For the bites of all kinds of vipers give two pills; and if the poison be not counteracted within half an hour give two pills more: but if the life of the patient be in great danger, four pills may be given. For the bite of all other less poisonous snakes, one pill, every morning for three days, is sufficient.' 'Two bottles of warm Madeira wine was forcibly poured into the patient's mouth, who then completely recovered.'

Further details on the administration of the pills and post-administration patient management are as follows[18]:

> 'The wound (note 12) is also scarified, in order to give it a greater opening, and the hot liver of a lamb, or some warm and soft substance, is applied to it, that a suppuration [the act of formation of pus] may take place (note 13) … one (pill) may be crushed and applied to the wound. The (food) regimen of the patient ought to be boiled rice or milk, to abstain from salt, and to drink only water. The patient must also be prevented from sleeping for the first twenty-four hours.'

The *Encyclopædia Perthensis* (ref. 19, p. 350) indicates that the Tanjore pills were used in the treatment of hydrophobia:

> 'Though these pills are principally used against the bite of cobra-de-capello, yet for the prevention of rabies canina, one is taken every morning for some length of time.'

Remarks

Alcohol was considered to play a role in activating and reviving the nerve centres after an animal bite, especially in the medical practice of the Middle-East in the 16th–18th centuries[20] (note 14). Because Russell had lived in Aleppo (the Ottoman Empire) before arriving in the Coromandel (India), he may have picked up this practice of administering alcohol to snake-bitten patients as a possible trigger factor to invigorate the efficacy of the Tanjore pills. No notation explains that the southern Indian vaidyans administered alcohol in any form to persons bitten by snakes. In fact, Ayûrvéda contraindicates use of alcohol in snake bite, because alcohol and snake venom can augment each other as they have many properties in common, but work against the ojas (note 15).

Gray's Pharmacœpia (ref. 15, p. 437) indicates that the pills were useful against rabid-dog bites and in treating elephantiasis. Whereas the practice of using these pills in treating patients bitten by rabid dogs existed in the 17th–18th centuries, how come these pills were found useful in treating elephantiasis – a disease caused by different species of parasitic onchocercids (Nematoda: Spirurida) transmitted by culicine and anopheline mosquitoes – in the 19th century is unclear. References to the use of arsenic occur in Ayûrvedic texts such as *Rasaratnasamuçaya*, *Sidda Prayôga Sangraha*, *Rasapradipikã*, *Basavarãjtya*, *Rasatarngini* (e.g. *šanka viša* – white arsenic; *gauri pãšanã* – As_2S_5) (note 16). These preparations were and are used in treating gout, lepromatous afflictions, respiratory illnesses, and joint pains (pers. commun., T. Thirunarayanan, Centre for Traditional Medicine and Research, Madras, e-mail, 22 October 2012). What needs to be factored here is that, up to the mid-19th century, lepromatous afflictions were considered elephantiasis (ref. 21, p. 357).

Gray's Pharmacœpia[15] also indicates that these pills were used in treating lues (syphilis). Ãther Ãli Khãn, the son of Nãder Shah's (Shah of Iran, *r*. 1736–1747) physician, indicates the use of arsenic-based compounds in treating leprosy, syphilis, and a few blood disorders. William Jones, the Indologist–Orientalist of Calcutta has indicated the use and relevance of arsenic-based medications, by alluding to the arsenic including the Tanjore pills based on James Anderson's remarks on the pills in Madras in *Asiatick Researches* (volume II), he edited from Calcutta (ref. 22, p. 317).

Although arsenic is deadly, it has been used in Western pharmaco-therapeutics in different ways. In the last 150 years, arsenic has been used for treating dermatitis, herpetiformis, asthma, syphilis, epilepsy, psoriasis, trypanosomiasis and amœbiasis[23]. Patients with the cancer of blood and bone marrow (e.g. acute promyelocytic leukaemia) are treated with arsenic trioxide[24]. Positive outcomes have been demonstrated on the usefulness of low doses of arsenic trioxide in enabling an efficient asthma management[25]. Arsenic trioxide (orpiment) has been used historically in Chinese traditional medicine in the treatment of snake bites and insect stings[26].

Of the many pyrrolizidine alkaloids that occur in *P. nigrum*, piperine is useful as a central nervous system stimulant, an analgesic and an antipyretic. The capacity of *P. nigrum* to act against a few Gram-positive and Gram-negative bacteria has been shown[27].Whereas various casual reports speak on the usefulness of *P. nigrum* against snake venom, Chahal *et al*.[27] indicate three other species of *Piper*, viz. *longum*, *marginatum* and *syhaticum*, as useful in treating snake poisoning. *Croton tiglium*, which includes glyceryl crotonate, coronic acid and crotonic resin as principal metabolites, is referred extensively in Ayûrvéda as useful in treating snake bites. Nevertheless, in the Tanjore pills, the role of *C. tiglium* rests solely as a purgative. The 'Ayurvedic and natural home remedies for a healthy living' website[28] indicates several uses for *C. gigantea* and its latex. For example, under the subheading 'Remedy for poisonous snake bites', this site indicates:

> 'If bitten by poisonous snakes, few leaves of the plant are plucked and chewed. Alternatively, the roots of the plant are crushed and the juice is applied over the bitten area.'

The latex of *Calotropis gigantea* is supposed to have mercury-like effects on the human body and is referred as vegetable mercury, and used instead of mercury in aphrodisiacal preparations[29]. Nevertheless, two concurrent studies (Brazil[30] and India[31]) on the latex of *C. procera* offer conflicting details. The Brazilian study implicates the anti-inflammatory role of the latex of *C. procera*, whereas the Indian study implicates it as an inflammatory agent. The relevance of grinding the latex of *C. gigantea* in mercury is alluded to in the treatment of snake and rabid-dog bites (ref. 32, pp. 49–50):

> 'Many mineral ingredients are used in the preparations of [traditional medicines, such as], *Mṛtasañjīvanī*, *Mṛtyuñjaya*, *Jīvarakṣa* and *Garuḍāñjanam*, and so on. Mineral ingredients, [such as] mercury, sulphur and arsenic are used in various drug preparations. Some ingredients have to be immersed in the latex of *arka* (*Calotropis gigantea*), *snuhī* (*Euphorbia ligularia*) for 14 days and then ground into a paste in the same medium. Such medicines give quick results and are very potent. Mercury is only mildly purified before it is administrated in cases of snake poison. One coin weight of mercury is purified by grinding in betel (Skt. *tāmbūla*; *Piper betle* Linn.) leaf juice. Sulphur (Skt. *gandhaka*), realgar (Skt. *manaḥśilā*), orpiment (Skt. *haritāla*) and so forth are also mineral substances that may be used. *Pāṣāṇa* is not used. It (*pāṣāṇa*) is dangerous and risky. These medicines should be administered with a clear understanding of the intensity of the poison. If one gives very strong medicines in a case of mild poisoning, the consequences will be injurious.'

The roots of *Aconitum ferox*, a Himalayan native, were known as poison for ages in India. However, in microquantities, these roots are used in traditional Indian pharmacopiae as a remedy for diverse illnesses, by exploiting the alkaloid pseudaconitine (nepaline). Homeopathic Pharmacopiae suggest its efficacy – obviously in minute quantities –, as a diuretic, and valuable in treating cardia dyspnoea, neuralgia and gout. Roots of *A. heterophyllum* and *A. bisma* are indicated against snake poisoning and not those of *A. ferox*[33,34]. *Aconitum* includes several flavonoid glycosides, besides pseudaconitine. What remains unexplained is how the roots and leaves of *A. ferox* help in managing snake poisoning in mammals. The roots of *L. acidissima*, a highly valued fruit tree, are indicated for snake bites (ref. 34, vol. 1, pp. 496–498), although how its active

principles work remains unexplained. Intense poisons were used in a regulated manner and in measured quantities to alleviate humans from the effects of animal poisons. Does this reinforce the adage: 'use a thorn to remove a thorn'?

Conclusion

The Tanjore pills generated heated debates in the erstwhile Madras Presidency: some favouring them and others not. A few others thought of them favourably initially and changed views later. Undeniably, these pills included certain plant and mineral ingredients that indicate an anti-venom capacity; or at least believed to relieve discomfort. But whether the pills – as a medication – truly had a remedial effect or were creating a placebo effect remains unestablished. What is exciting, however, is that these pills rocked medical scientists and practitioners not only in the Madras Presidency, but also in the remainder of the world in the 18th–19th centuries. Curious that the principle applied in the Tanjore pills reminds us of the Hippocratic dictum *Similia similibus curantur* (the like cures the like), which Samuel Hahnemann validated as the cardinal doctrine in Homeopathy (ref. 35, p. 48).

The following occurs in ref. 36:

'… A man who is poisoned may be cured by another poison, the antidote …'

– Ãryadévã in *Çitta-Visuddi-Prakãrãnã* (*c*. 3rd century AD).

Notes

1. Ŧanjavur (10°46′N; 79°7′E), Tamil Nadu, known as 'Tanjore' during the British days.
2. Christian Friedrich Schwarz (1726–1798), a Lutheran Missionary, came to Tranquebar, India, in 1750. Later at *Ŧanjãvur*, Schwarz mentored Sarabéndra Bhupãla Bhoslé (*Sarabôji* II, 1777–1832) of Ŧanjãvur. *Sarabôji* gained mastery over several European and Indian languages, music and science studying with Wilhelm Gericke in Madras[37].
3. *Fano* (*fanam*, corruption of *panam*, *Tamizh*) was a denomination of currency issued in the Madras Presidency until 1815. The *fanam* was a silver coin, subdivided into 80 copper coins; a gold *pagoda* = 42 *fanam-s*.
4. A *Star Pagoda* = 8 schillings, a coin issued by the East-India Company. *Madras Courier*: first newspaper started on 12 October 1785, published by Richard Johnston, the East-India Company's Printer.
5. The full name of 'Mr Strange' was not traceable. Chakrabarti[6] refers to Strange as surgeon. One 'James Charles Stuart Strange' (1753—1840) was the Collector and Paymaster of Tanjore until retirement in 1795 (ref. 38, p. 470). Possibly Mr Strange and James Strange refer to the same person (ref. 39, p. 53).
6. Chakrabarti[6] refers as a 'native' practitioner. John[5] refers to one 'Samuel, a former servant of Frederick Schwarz' implying him the 'practitioner'. The *Scots Magazine*[12] refers to a 'Brahmin' in the same context (p. 907). Possibly the terms 'native practitioner', 'Samuel' and 'Brahmin'[39] refer to the same person, since adoption of Christianity by Hindus was common then.
7. *Eau de Luce* (water of Luce), called so after its inventor, made by dissolving white soap in wine and adding the oil of amber and sal ammoniac[40]. It is a milky fluid, antispasmodio and stimulant. A paper in the *Lancet* exists referring to its use in treating snake bites[41].
8. *Gentoo – Ŧélugu*.
9. 'Arsen. alb.'– arsenicum album; 'ʒ' – drachm; 'pip. nigri' – *Piper nigrum*. Gray[15] does not refer to the other ingredients, such as mercury and plants. This citation indicates the usefulness of these pills against hydrophobia; also refers to their use in treating elephantiasis and lues (= syphilis).
10. Grinding mercury into the latex of *Calotropis gigantea* is explained in Dash (ref. 42, p. 110); He refers to wild cotton tree as *arkã* (*Calotropis gigantea*).
11. A grain as an apothecary's measure (Imperial units of measurement) is 64.8 mg, based on the mass of a single grain of barley.
12. The wound due to snake bite.
13. Why inducing pus formation was necessary is not clear. Pus formation occurs when a body site is infected[43]. Why an infection needs to be deliberately introduced? Was that an effort to provoke the innate-immune system to respond and thus heal?
14. *Ojas* – the essential energy required for life (*Ayûrvéda*).
15. Use of arsenic in medical practice became widespread after the development of the branch of *Rasasãstra* in *Ayûrvéda*. In the *Siddha* system of medicine arsenic has been used in formulations for long, especially as realgar and orpiment. Classical *Ayûrvéda* texts refer to arsenic compounds. However, they are not mentioned in treating either snake bites or rabies. The Kerala tradition of *višavaidya*s use minerals and metals in formulations to treat snake bites.
16. Use of the term '*lepra*' for 'psoriasis' in the mid-19th century is equally confusing[43].

1. Bhat, S. and Udupa, K., *Asian Pac. J. Trop. Biomed.*, 2013, **3**, 668–672.
2. Swaroop, S. and Grab, B., *Bull. WHO*, 1954, **10**, 35–76.
3. Hawgood, B. J., *Toxicon*, 1999, **37**, 1241–1258.
4. Mohanavelu, C. S., Annotated Bibliography for Tamil Studies Conducted by Germans in Tamilnadu during 18th and 19th Centuries: A Virtual Digital Archives Project, University Grants Commission, New Delhi, 2010, p. 525.
5. John, C. S., *Neuere Geschichte der evangelischen Missions – Anstalten in Ostindien aus den eigenhändigen Aufsatzen und Briefen der Missionaire*, Halle Waisenhaus, Halle, Germany, 1793, p. 648.
6. Chakrabarti, P., *Bull. Hist. Med*., 2006, **80**, 1–38.
7. Duffin, W., *Minute to the Madras Hospital Board*, The National Archives, London, 17 November 1788, pp. 238–241.
8. Raman, A., *Curr. Sci.*, 2011, **100**, 1092–1096.
9. Raman, A., *J. Bombay Nat. Hist. Soc*., 2010, **107**, 116–121.
10. Anon., *Month. Rev.* (*Lit. J.*), 1798, **26**, 72–73.
11. Duncan, A. and Duncan, A., *Ann. Med.*, 1798, **2**, 1–18.
12. Anon., *Scots Mag., Edin. Lit. Misc.,* 1811, **73**, 904–910.
13. Orfila, M. J. B., *A General System of Toxicology* (Second edition, translated by Waller, J. A.), E. Cox & Son, London, 1821, p. 568.
14. Parr, B., *The London Medical Dictionary; Including Under Distinct Heads Every Branch of Medicine*, printed for Johnson, J. *et al.*, London, 1809, vol. II, pp. 755.
15. Gray, S. F., *A Supplement to the Pharmacopœia, and A Treatise on Pharmacology in General*, Longman, Rees, Orme, Brown, Green, and Longman, London, 1836, p. 629.
16. Hooper, R., *The Surgeon's vade-mecum:* …., John Murray, London, 1809, p. 269.
17. Chevalier, T., *Medico-Chirur. Trans.*, 1811, **2**, 403–404.
18. Anon., *Asiat. J. Month. Regis. Br. India Dependen*., 1816, **2**, 381.
19. Encyclopædia Perthensis, *The Universal Dictionary of the Arts, Sciences, Literature, &c.*…, John Brown, Edinburgh, 1816, vol. 14, p. 771.

20. Azaizeh, H., Saad, B., Khalil, K. and Said, O., *Evid.-based Complement Altern. Med*., 2006, **3**, 229–235.
21. Wilson, E., *Diseases of the Skin*, John Churchill, London, 1863, 5th edn, p. 784.
22. Franklin, M. J., *Orientalist Jones (Sir William Jones, Poet, Lawyer, and Linguist, 1746–1794)*, Oxford University Press, New York, 2011, p. 396.
23. WHO, Arsenic. World Health Organization, Geneva, 1981, p. 174.
24. Mervis, J., *Science*, 1996, **273**, 578.
25. Lin-fu, Z., Kai-sheng, Y. and Zhi-min, Z., *Chin. J. Integr. Med*., 2003, **9**, 281–284.
26. Liu, J., Lu, Y., Wu, Q., Goyer, R. A. and Waalkes, M. P., *J. Pharmacol. Exp. Ther*., 2008, **326**, 363–368.
27. Chahal, J., Ohlyan, R., Kandale, A., Walia, A. and Puri, S., *Int. J. Curr. Pharm. Rev. Res*., 2011, **2**, 130–144.
28. Ayurvedic and natural home remedies for a healthy living, 2013; http://www.ayurvedicnaturalhome.remedies.com/calotropis-gigantea/ (accessed on 18 November 2013).
29. Singh, V., *Open J. Stomatol.*, 2012, **2**, 149–152.
30. Alencar, N. M. N., Figueiredo, I. S. T., Vale, M. R., Bitencurt, F. S., Oliveira, J. S., Ribeiro, R. A. and Ramos, M. V., *Planta Med.*, 2004, **70**, 1144–1149.
31. Kumar, V. L. and Shivkar, Y. M., *Mediat. Inflamm*., 2003, **13**, 151–155.
32. Yamashita, T. and Ram Manohar, P., *eJ. Indian Med*., 2007–2008, **1**, 43–60.
33. Hussain, S. and Hore, D. K., *Indian J. Trad. Knowl.*, 2008, **6**, 352–357.
34. Shyaula, S. L., *Nepal J. Sci. Tech*., 2011, **12**, 171–178.
35. Devrient, C. H. and Stratten, S., *The Homœopathic Medical Doctrine, or Organon of the Healing Art: A New System of Physic* (translated from German by Hahnemann, S.), W.F. Wakeman, Dublin, 1833, p. 332.
36. Kirtikar, K. R., Basu, B. D. and An, I. C. S., *Indian Medicinal Plants*, *Volume I*, Orient Enterprises, Dehradun, 1993.
37. Page, J., *Schwarz of Tanjore*, The Society for Promoting Christian Knowledge, The Macmillan Company, London, 1921, p. 203.
38. Buckland, C. E., *Dictionary of Indian Biography*, Swan Sonneschein & Co, London, 1906, p. 520.
39. Hosie, J., *Rep. Proc. Br. Colum. Hist. Assoc*., 1929, **4**, 43–54.
40. Anon., *Eur. Mag. London Rev*., 1811, **59–60**, 3–8.
41. Barnes, R., *Lancet*, 1852, **60**, 431–432.
42. Dash, V. B., *Alchemy and Metallic Medicines in Ayurveda*, Concept Publishing Company, New Delhi, 1986, p. 241.
43. Ryan, T. J., *Lymphology*, 2009, **42**, 19–25.

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