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Taxonomical outlines of bio-diversity of Karnataka in a 14th century Kannada toxicology text Khagendra Mani Darpana

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PEER REVIEW

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Comments

Toxicology is a branch which caters to emergency in rural scenario and the text deals with extensively on poisonous and antidotes, management of poisons from animate and inanimate which are elaborately described. The author has rightly chosen the high impact facts and woven into an interesting article.
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ABSTRACT

Origin of ancient Indian toxicology can be dated back to vedic literature. Toxins of both animate and inanimate world were very well understood during the era. Rig and Atharva vedic texts describe such details. After classifying such toxins, Charaka Samhitha, the basic literature of Indian Medicine used gold and ghee as panaceas to counter act them. Ayurveda considers toxicology as one among the eight specialized branches of medical wisdom. Unfortunately, the available literature on this is very limited. Moreover, they have been discussed briefly in Charaka and Sushruta Samhitha. Mangarasa I, a Jain scholar who lived on the foothills of the Western Ghats, in Southern India in 1350 A.D., felt this vacuum and composed an independent, elaborate Kannada text on toxicology. His less known text Khagendra Mani Darpana (KMD) is the first ever documented complete text on toxicology in the world. Medieval Indian wisdom on plant and animal diversities are very well reflected in this unique toxicological text. Centuries past to Linnean era, KMD gives vivid descriptions on zoological and botanical diversities of the time. This astonishing fact is an evidence of our ancestor's curiosities about the nature around them. A critical overview of the bio-diversity described in KMD text is discussed in this paper.

KEYWORDS

Biodiversity, Khagendra Mani Darpana, Toxicology

1. Introduction

Vedic literature gives us a fair idea of venoms and poisons along with remedial procedures. Poisons of mineral, plant and animal origin were known and well documented in Atharva Veda texts. During Alexandrian era, the poison therapists were called as Agandankaras. They even helped the Greek army who were unaware of tropical snake bites. Looking at the success of such a wise man, Alexander was impressed and took such people with him. Kautilya's Arthashastra made some observations on protecting the King from being

poisoned. He also hinted on poisoning enemies horses and using maids to poison royal families. Slow poisoning was also narrated in detail in the text. Major texts of Ayurveda includes toxicology among the eight major divisions of Ayurveda. All the descriptions seen in Kautilya's text are also verbally codified in the medical works of Sushruta Samhitha and Charaka Samhitha. But not even a single independent work on this branch is available to us today.

Khagendra Mani Darpana (KMD) fills up vacuum and makes its study most crucial in the present context. It is a poetical work in Kannada with 16 chapters, comprising 1500 verses

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which were compiled by a Jain Prince Mangarasa I, during 1350 A.D. It is regarded as the world's first complete work fully dedicated to toxicology. The author lived in a place known as Chikka Mugulipura. It is identified as Mugulavalli, situated about five kilometers from Chikkamagalur district, towards Hassan road. High rainfall attracting dense wet evergreen forests and hilly tracts of loftiest peaks with enchanting landscaping, green grass lands of Western Ghats are the special features of the district in the preset era. This is the supposed geographical location of composition of KMD text which is an abode of rich biological diversity even in today.

Besides the immense value of KMD text as a great monograph on toxicology, it is also very well known for its literature ethos. The composition was considered as one of the milestones of Kannada literature during medieval era. The language of the text is quite simple and unambiguous with lesser use of Sanskrit words. There are some exquisite figure of speech besides idioms. Although the text is in Kannada, it is reflecting a pan Indian heritage of toxicology. However, no attempts were made to decode the text for its actual contribution to the subject of toxicology. This paper attempts to present an overview of bio-diversity present in the book with a critical emphasis on both botanical and zoological entities.

About six decades ago, it was estimated that there was about half a million snakes bites with 40000 reported fatalities annually^[1]. All such deaths happened owing to neuro muscular atrophy, congestive cardiac failure, bleeding and hypotension. The role of procedures and drugs mentioned in KMD text in such casualty is worth evaluating in the present context. The core theme of KMD is cause, signs and symptoms as well as management of all types of poisonous contacts of mankind. Such poisons might have been originated from diverse sources such as minerals, plants and animals.

2. Literature review

Six palm leaf manuscripts were used to publish the original first printed edition of KMD. During the year 1942, such printed Kannada edition was published by Department of Kannada, University of Madras^[2]. This original text contains elaborate introductory chapter both in Kannada and English. It has authoritative remarks on KMD author, its time and contents of the text. This is the basic text used for decoding the bio-diversity contents of it. Twelve books and 35 subject experts were consulted to arrive at conclusions in this regard. An extensive field work was conducted to understand few phenomena explained in the text by the author. A decade long research was undertaken with a special emphasis towards documenting the barefoot snake bites healers. Efforts were made to establish the place of KMD composition and its author. Earlier work did not elaborate on it, except mentioning name of place Mugulipura.

The list, though exhaustive, was only limited taxonomical classification. A total of 955 plant drugs are enlisted. They were identified with 438 binomials that belong to 116 families. Additional plant drugs which were not mentioned in classical texts of Ayurveda were listed as new entries to Ayurvedic pharmacopea.

3. Botanical diversity

KMD is a treasure house of technical terms including zoological and botanical diversities of the era. Over 955 names referring to plants, figure in the 16 chapters of the text.

The present authors have established botanical identities of these names under 438 binomials, which fall under 116 families.

Aconitum heterophyllum and *Aconitum ferox* are two Sub Himalayan Ranunculaceae members. The roots of such plants were traded across India during KMD era^[2]. Incidentally, a Homeopathic principle like "Similia Similibus curentur—likes are cured by likes" is reflected in the present as well as elsewhere in KMD text centuries past to Hahnemann era (1755–1843). Vathsanabha (*Aconitum ferox*) is a deadly poison in large doses. For the management of such poison case, in view of neutralizing it, agents like less toxic or non toxic Athibaje or Athivisha (*Aconitum heterophyllum*) was used^[2]. Poison effects of incompatibility of vegetable fats and edible oils is neutralized by using animal fat, ghee^[2]. Phytochemical evaluations may lead us to conclusion, how such treatments work. Another verse reads like this: If a poison plant thorn penetrates into body, the paste of the leaves of the same plant is used for anointing the wound surface. This gives a sure cure^[2]. This also proves to be an early evidence of homeopathy doctrine.

Anguru and Ashwagandha are the two plant names figured in the text^[2]. Malayalam name for the root of Ashwagandha is Amukura, sounding similar to Angura referred in KMD. But, the source plant of Ashwagandha is neither endemic to Kerala nor to Coastal Karnataka. People from north part of Karnataka, still refer the name Anguru. It may be inferred that, both wild and cultivated forms of lean (kaddi) and stout root (nagori). Ashwagandha was available during KMD era. Such traded roots might have been referred as Anguru/ Amukuru and wild roots dug fresh might have been known as Ashwagandha.

Two poisonous plants are described as Kanigila and Ashwamari. *Nerium indicum* and *Thevetia peruviana* are the two Apocynaceae members used for killing war horses during warfare's in India right from Guptha era. Even today, both plants are identified under the same names as Kanigila and Hayamara. Signs of such poison and management of both plants are well narrated including a reference to its terminal inflorescence^[2]. Kutajadwandwa is a panacea remedy for alleviate all poisons. It is figured in the text to refer twin plants^[2]. The plants may be identified as *Holarrhena pubescens* and *Wrightea tinctoria*. Both plants have least morphological

similarities except strong similar floral characters. Still KMD considered it as relative trees and called them as Kutaja twin. Incidentally, both belong to Apocynaceae. A reputed barefoot healer Sri., Narayana Murthy, near Sagara taluk, Shimoga district, Karnataka, used both of these trees for treating malignancy (oral communication). *Crape jasmine* or Nandyavartha (*Tabernaemontana divericata*) is another member of Apocynaceae family. It was widely used as poison alleviator^[2]. Taiwan and Caribbean studies reveal the anti-cancer and cytotoxic properties of the indole alkaloids of *Crape Jasmine*^[3].

The edible tuberous plants such as Kesavi (*Colocasia indica*) and Balirakkasi (*Alocasia antiqourum*) are similar in physical appearance. Surana (*Amorphopallus dubius*) does not have any morphological similarity. But all the three plants are described one after another^[2]. Modern systematic botany considers these three plants under one family Araceae. It may not be just coincidence to note the description of five types of edible citrus fruits (*Naranga*, *Herile*, *Kitteele*, *Nimbe* and *Madala*) one after another^[2]. The edible drum stick is referred as Nuggi (*Moringa pterygosperma*) in the text and its wild relative as Kalnuggi. This potential germplasm may be explored for high yield and disease free drumstick.

Hallucinogenic Bhangī (*Cannabis indica*) was described along with management of intoxication^[2]. Anabe (mushroom like *Agaricus* sp.,) explained for the first time in the text^[2]. Classical Ayurveda texts did not mention the use of Loysara (*Aloe vera*). Mangarasa mentions extensive uses of the same for medicinal purposes^[2]. Probably, this plant might have been introduced in to India after the invasion of Arabs from Middle East.

Over 13 verses are dedicated to manage the poisonous effects of Geru (*Semecarpus anacardium*) is very unique^[2]. Probably the trees were very abundant in Karnataka and the blisters were commonly encountered, obviating the multiple management procedures. Indeed, this was also an important fruit during the times with multiple uses like food and medicine. Oil expressed from the seed was used in house building and religious purposes like making of Ishtalinga or an amulet icon in Veerashaivism Bhat (1992).

Visha mungari or mungari (*Crinum defixum*) is a well known plant in the eastern plains of Karnataka. KMD gives a fair account of both therapeutic and poisonous nature of this plant^[2]. Currently in front each barber shop, this plant is raised in the form of customary. The reason of such rising is unknown. Barbers sometimes say that the gregarious growth of the plant is symbolized with profuse growth of hairs of the clients who visit such saloons. But the classical texts of Ayurveda claim that such plants have styptic (blood co-agulating), anti-inflammatory as well as antibacterial and anti-viral activities. That may be actual reason behind growing these plants in front of each barber saloon, particularly in eastern plains of Karnataka. As a matter of fact, the historians opine that the barbers are actual legacy of

surgical schools of Indian as well as western medicine.

Nine types of mono cot cereals and minor millet's including bamboo were described in the similar fashion^[2]. Further more, eight types of edible pulses were described^[2]. Thus KMD author has established his eminence in categorizing plants in the text. Incidentally, many plant diversities like *Phyllanthus embelica*, *Phyllanthus amarus*, *Eclipta alba*, mentioned for antivenom treatment in KMD is used for similar purposes across the Indian sub-continent by various tribal communities^[4]. In Bangladesh, there has been reports of plant diversities used in snake bite management by rural folk^[5]. Interestingly, 28 such plant diversities are the same which are used in KMD. Kenyan researchers opine some of the plants like *Grewia* sp., *Indigofera circinella* and *Solanum incanum* are used at Kenyan communities as antivenins^[6]. These are some prime genus indicated at poison management in KMD. Recent research also reveals that some of the plant diversities used in KMD text show antimicrobial activities particularly in oral cancer cases^[7]. Other reports reveal that Sogade (*Hemidesmus indicus* R. Br) possessed viper venom inhibitory activity. HI–RVIF significantly antagonized viper venom–induced lethal, haemorrhagic, coagulant and anticoagulant activity in experimental rodents. Further, a hyaluronidase inhibitor glycoprotein (WSG) was purified from *Withania somnifera*. The glycoprotein inhibited the hyaluronidase activity of cobra (*Naja naja*) and viper (*Daboia russelii*) venoms, which was demonstrated by zymogram assay and staining of the skin tissues for differential activity^[8].

4. Zoological diversity

List of zoological diversity is exhaustive, viz. reptiles, amphibians, both herbivorous and carnivorous mammals, arthropod animals like scorpions, caterpillar like many insects, including leech as well as few birds. One exclusive chapter deals on rats and rodents of the past millennium. Many of domestic animals including camels and horses and mammalian rabidity are well described.

Indian cobra (*Naja naja*) and King cobra (*Ophiophagus hannah*) are described under eight mythological and mystic serpents^[2]. Twenty one types of kraits and vipers were described under a separate chapter^[2]. Wolf snake (*Lycodon aulicus*) mimicking descriptions may be elicited in the same chapter. Incidentally, such snakes are still found in the geographical area where the text was originally composed^[4]. A distinct note on snakes of wild and village neighborhood is very interesting. Mostly, author might consider rat snake (*Ptyas mucosus*) as a village snake and such beliefs still persist in coastal Karnataka. Crocodile bite and signs as well as treatment are also described^[2].

The exclusive chapter with 52 verses, on scorpions is dealing with the systematic classification of arthropods^[2]. Author explains 13 types of scorpions. Rings (band) over the body are

the major prognostic tool in the management of such bites. If bands are of even number, the case has good prognosis and otherwise if odd^[2]. Presently, only three kinds of scorpions (black rock, large red – field and little red– house scorpions) are listed in the district fauna^[9].

Eighteen types of rats and rodents are described in an exclusive chapter with morphology and bite signs and management methods^[2]. These wild rat and rodent population was actually a menace during the era of the KMD. Therefore, author might have significantly contributed the original and first hand information on the types and races of rats and rodents of his era with bite poison signs and symptoms with management techniques. No doubt, the old texts of Ayurveda like Sushruta Samhitha and Ashtanaga Samgraha deal with the rat bite in a separate chapter^[10]. But the information is not so exhaustive like it is found in KMD.

Diverse animals are described in the 13th chapter which is very large and extensive with 156 verses (one tenth part of the whole text). The chapter is dedicated for the management of poisons originated by all mobile creatures (jangama visha). Wild animals like Vrika (wolf), Shardoola (lion like mighty mystic animal), elephant, Gomayu (mighty wild cow or yak), aquatic fauna like Kacchapa (tortoise), Shimshumara (*Gangetic dolphin*), Makara (crocodile), avians like Lavaka (a bird), Paravata (pigeon), Makshika (fly), Kshudra pipilika (little ant) are the few names mentioned in the very beginning introductory stanzas of the chapter. Later on, all such minute diversity is dealt one by one with individual descriptions.

Tiger (*Panthera tigris*) is dealt in detail. Interestingly a charm (mantra) is spelt to deal with the wild tiger under the name of Vyaghra mukha sthambhana mantra^[2]. This literally means tying the tiger mouth with the help of a magic spell. Current era, an emerging science deals with the animal behavior known as ethology. Taming the wild animals like elephant and tiger were common in medieval India. It may infer that true Jain nonviolent spirits must have nurtured such ideas of mesmerizing the cruel animal with out least harm to violent wild animals. Such charms prevailed during the era must have helped our ancestors to drive away cruel creatures with out harming such wild species. KMD elaborates many of such hypnotizing charms through out the text.

Sloth Bear (*Melursus ursinus*) attack was explained with management^[2]. Wild boar (*Sus scrofa cristatus*) attacks not only prevailed during the author's era^[2]. Here is a news paper report on one of such attack happened recently. In the early hours of 10th September 2011, a stout wild boar strayed in to the town of Mudigere (Chikmagalur dist) and injured a woman. All four members of Canidae like Thola (*Canis lupus pallipus*), Seelnayi (*Cuon alpinus*), rabid dog (*Canis lupus familiaris*) and Nari (*Canis aureus indicus*) bites are dealt one after another in the respective order along with detailed methods of management^[2]. Cat (*Felis catus*) and Hebbala bekku – wild cat (*Felix chaus*) as well as civet cat (*Viverricula indica*) are described with bite sign and treatment.

Munguri– common dwarf mongoose (*Halogale parvula*) was also referred as nakula in the text^[2]. Three types of apes were referred in the text under their colloquial names like Vanara – Bonnet macaque (*Macaca radiata*), Musu – Hanuman Langoor (*Semnopithecus* sp.) and presently a RET species Singaleeka– lion tailed Macaque (*Macaca silenus*)^[2]. After referring to elephant encounter four domestic animal bites are described such as cow, horse, camel and donkey^[2].

Doddina mriga (*Antelope cervicapra*), Kadavu or Sambar stag (*Cervus unicolor*) and Hulle saranga (*Axis axis*) are the four antelopes under Bovidae^[2]. Subsequently, management of injuries caused by wild Indian buffalo (*Bubulus arnee*), both male and female are quoted^[2]. Names of other wild mammals which are widely domesticated presently are Adu (*Capra aegagrus*), Hota (male goat) and Kuri (*Ovis species*)^[2]. Mola or Indian hare (*Lepus nigricollis*) and Eyyamriga or porcupine (*Hystrix indica*) are the common wild terrestrial mammals. Author has described and indicated the treatment in such animal encounters. Just after a rodentia sub species of *Hystrix indica*^[2], later verses explain two squirrels. *Ratufa indica* is the Malbar giant squirrel, presently a RET species as per IUCN, is referred as kembanganilu (literal translation would mean red squirrel)^[2]. Small palm squirrel (*Fumambulus palmarum*) was called as Sannalilu^[2]. Incidentally, present Linnaean systematic puts squirrels under the order rodentia.

Under the present sub phyla chordata, Reptilia, six diversities are explained one after another. Udu or Indian Monitor lizard (*Varanus* sp.), Othi (*Chameleon zeylanicus*), Gosumbe (*Chameleon chameleon*), Havarane–rock lizard (wild gecko) and lizard (*Hemidactylus frenatus*) are the first five in the series respectively^[2]. Last described species is the largest one, among all reptiles, crocodile bite and its management^[2].

Aquatic diversities are pooled together while describing in KMD text. Cure for fish bite^[2], Edi or terrestrial crab bite (*Gecarcoidia natalis*), Kappe or frog (*Rana* sp.) bite and jigule or leech bite (*Hirudo medicinalis*) signs and treatment are described respectively^[2]. A passing reference on avian poison through bite or drop, urine and its treatment is found^[2].

Entomological par excellence of the era is reflected in 27 verses of KMD text. Kannada names of at least 14 insect diversities can be quoted from the book. Thumbi (Beetle), Kadanduru (hornet), Jena nona (*Apis* sp.), Nona (house fly–*Musca domestica*), Kambali hulu (wooly bear cater piller), Koda hulu (any horned insect), Tagune (bed bug–*Cimex* spp.), Iruve (ant), Kenjiga (fire ant–*Solonopsis* spp.), Bacchala pulu (waste water drain worm), Noraju–Gunguru (singing cicada) and Keetaka (any insect) are such names.

5. Conclusion

Thus KMD text is a very unique in describing the bio-diversity of the past millenia. Its author Mangarsa (1350 A.D.) was very wise to classify systematically, the plant and animal

diversity, several centuries earlier to Carolos Linnaeus (1735 A.D). Although KMD is a first text on toxicology, its distinct features on plant and animal taxonomy is noteworthy. In this paper, we have attempted to re-introduce these features of KMD to a wider audience. Since snake bite is one of the most neglected public health issues in poor rural communities living in the tropics. Because of serious misreporting, the true worldwide burden of snake bite is not known^[1].

There is a wider scope for developing potential anti-dotes for poisons based on further systematic studies of this text. Further studies on rodenticidal, insecticidal plants listed in the text are needed. The management of thermal injuries as mentioned in the book is worth investigating in the light of modern sciences. Thus, KMD throws open its avenues for an array of inter-disciplinary studies.

Conflict of interest statement

We declare that we have no conflict of interest.

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Comments

Background

History of medicine is medicine itself, so the ancient text book on toxicology is literary research worth investigating not only for its historical importance but also to learn, research and adopt many important formulations and application of medical devices from this 14th century book exclusively devoted to toxicology.

Research frontiers

Flora fauna enrich biodiversity, its study and toxicological importance. Management of poisons from animal bites and plant sources have been highlighted. It is a very unique study of plants in which the morphology, classification, and identification are described.

Related reports

Malayalam texts like Visha Jyotsnika, Prayoga Samucchayam, Visha Narayaniyam, Lakshanamrtam and Kriya Kaumudi are supposed to be texts devoted to toxicology. But in Malayalam, Shivatatva ratnakara is an encyclopaedic work on toxicology, written in Samskrit, in the 17th century.

Innovations and breakthroughs

The unique and highly significant contributions to toxicology have been mentioned and this book needs not only publication in many languages but also extensive research before totally accepting the formulations and devices.

Applications

Anti dotes for poisons due to local poisonous flora and special mention of mantra to tame tiger are few worth mentioning to be adopted for trails apart from scorpion bites, rat types and many more wild animal bites have been well recorded. This not only speaks about the formulations and management but also about the long experience which resulted in the work.

Peer review

Toxicology is a branch which caters to emergency in rural scenario and the text deals with extensively on poisonous and antidotes, management of poisons from animate and inanimate which are elaborately described. The author has rightly chosen the high impact facts and woven into an interesting article.

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