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पूर्णस्य पूर्णमादाय पूर्णमेवावशिष्यते ॥

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Research Questions

A golden-mine for research questions in toxicology: Khagendramani Darpanam

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Abstract

The Khagendramani Darpanam (KMD), a seminal 14th-century work on Indian toxicology (Vishavaidya) authored by Mangaraja, represents an extensive yet largely unexplored "golden-mine" of traditional clinical wisdom. Written in Old Kannada (Halegannada), the text systematically categorizes toxins into inanimate (Sthāvara), animate (Jangama), and artificial (Kritrima) sources, offering nearly 600 medicinal plant remedies and complex herbo-mineral formulas. This paper identifies KMD as a fertile ground for modern pharmacological research, focusing on its sophisticated multi-modal treatment protocols for severe envenomation. The paper discusses the scope for research in KMD and appeals more and more researchers to work in the area to contribute to scientific validation of Indian Knowledge Systems and humanity at large. The paper suggests a couple of typical research questions for researchers to work on, as a sample; while hundreds of researchers can work on. Furthermore, the paper explores KMD's unique integration of psychosomatic acoustics (Mantra Chikitsa) and revival techniques (Kakapada), suggesting modern neuro-acoustic methodologies to measure autonomic stabilization. By bridging Mangaraja's holistic "Mani, Mantra, Mardu" approach with modern evidence-based medicine, this study underscores the text's potential to inform contemporary drug discovery, sepsis management, and emergency clinical protocols.

Keywords: Khagendramani Darpanam, Mangaraja, *Vishavaidya*, Toxicology, Research Methodology, Monitor Lizard Toxicity, Phytochemistry, Traditional Medicine.

Introduction

Toxicology, traditionally referred to as *Vishavaidya* in the Indian Knowledge Systems, is the scientific study of poisons (*visha*), their origins, their effects on

humans, animals or any living beings, and the methods used to neutralize them.

Khagendramani Darpanam (KMD) is a monumental 14th-century encyclopedia of Indian toxicology (*Vishavaidya*). Written by the poet-physician

Mangaraja in approximately 1350 CE, the work is composed in the Halegannada (Old Kannada) Champu style, which intricately weaves together prose and poetry. It is regarded as one of the most systematic and exhaustive treatises on the science of poisons within the Indian Knowledge Systems (IKS), uniquely documenting advanced medical wisdom in a regional language.

The text is organized into sixteen comprehensive chapters (*Adhikārās*) that detail the diagnosis, prognosis, and treatment of various envenomations. It classifies toxins into three primary categories:

- **Sthavara Visha:** Inanimate poisons derived from plants and minerals, identifying twenty-five distinct types including *Vatsanabha* and *Kalakuta*.
- **Jangama Visha:** Animate poisons from living creatures, detailing clinical protocols for the eight major lineages of serpents, scorpions, rats, rabid dogs, tigers, and even injuries from human teeth and nails.
- **Kritrima Visha:** Artificial or deceptive poisons surreptitiously introduced into food, drinks, or perfumes.

A distinguishing feature of the source is its psychosomatic approach to healing, which emphasizes the synchronization of medicine (*Aushadha*) with Mantras (incantations) and Mani (precious stones) to stabilize a patient's mental and physical state. The core clinical methodology described involves:

- **Pāna:** Medicated drinks to neutralize internal toxins.
- **Anjana:** Collyrium or medicated eye drops.
- **Nasya:** Nasal administration, based on the principle that the head is the primary seat of the nervous system.
- **Lepana:** Topical ointments and coatings applied to the site of the bite or wound.

Rooted in Jain medical traditions and drawing from the works of masters like Puṇyapāda, Mangarāja defines the fundamental philosophy of his work as "*sarvajānopakāra*"—the noble pursuit of providing benefit and protection to all living beings. The source also serves as a massive pharmacological repository, detailing over 600 medicinal plants and precise instructions for their collection based on seasons and soil conditions.

Contents of Khagendramani Darpanam

Khagendramani Darpana has 16 chapters, known as *Adhikārās*, which provide a systematic exploration of

Indian toxicology (*Vishavaidyā*). These chapters cover the classification of poisons, diagnostic methods, and a variety of clinical treatments ranging from herbal drugs to sound therapy. The contents of the 16 chapters (C1 to C12) are mentioned in brief, in the following paragraphs.

Prathamādhikāram (C1): *Sanjñā*

Prakaranam (ಸಂಜ್ಞಾ ಪ್ರಕರಣಂ)

This chapter introduces the science of toxicology, defining basic terminology and the intent of the work. It addresses the general classification of poisons and the foundational principles of diagnosis and prognosis. A significant portion is dedicated to "*Dhootā Lakshana*," or interpreting omens and signs from a messenger to determine the clinical outcome of a bite victim.

Dwitiyādhikāram (C2): *Sthāvaravisha*

Prakaranam (ಸ್ಥಾವರವಿಷ ಪ್ರಕರಣಂ)

The focus of this chapter is on inanimate poisons derived from approximately 25 different plant and mineral sources. It addresses the toxicity found in various parts of plants, such as roots, fruits, leaves, and flowers, including potent toxins like *Vatsanābha* and *Kālakoota*. The chapter details the symptoms caused by these inanimate poisons, such as diarrhea, fainting, and hallucinations, and provides extensive herbal remedies to neutralize them.

Trutiyādhikāram (C3): *Sangrahādhikāram*

(ಸಂಗ್ರಹಾಧಿಕಾರಂ)

This chapter begins the study of animate poisons (*Jangama Visha*), specifically focusing on the eight major lineages of serpents. It addresses the physical characteristics and toxic potential of snakes like *Ananta*, *Vāsuki*, and *Takshaka*. Clinical issues discussed include the patterns of bite wounds (*kshata*) and how different elemental forces like earth, water, and air influence the spread and symptoms of venom in the body.

Chaturtādhikāram (C4): *Gāruda*

Mantradhikāram (ಗಾರುಡಮಂತ್ರಾಧಿಕಾರಂ)

This chapter addresses the psychosomatic and vibrational aspects of poisoning through the science of *Mantras* (incantations). It provides specific auditory formulas designed to stabilize a victim's mental state and physically neutralize toxins. The chapter discusses how these *mantras* can be used for "*Stambhana*" (arresting the spread of poison) and "*Nirvisha*" (neutralization) during critical emergencies.

Panchamādhikāram (C5): *Pānādhikāram*

(ಪಾನಾಧಿಕಾರಂ)

Internal toxicity is the primary concern of this

chapter, specifically focusing on poisons that have entered the circulatory system and affected the seven tissues (Dhatus) of the body. It provides detailed protocols for administering medicated drinks (Pana) to treat the varying stages of snake envenomation. The chapter addresses symptoms occurring as venom progresses through different "vegās" or stages of intensity within the human body.

Shashtādhikāram (C6): Anjana Prakaranam (ಅಂಜನ ಪ್ರಕರಣಂ)

This chapter deals with toxicity that affects the eyes and vision, as well as the use of the eyes as a superior route for systemic detoxification. It addresses symptoms like ocular dimness and delusions caused by various poisons. The chapter details the preparation and application of "Anjana" (medicated collyrium) as a superior modality for reviving unconscious victims and clearing the mind.

Saptādhikāram (C7):

Nasya Prakaranam (ನಸ್ಯ ಪ್ರಕರಣಂ)

The toxicity issues addressed here concern the head and respiratory systems, based on the principle that the head is the "entrance" to the body's vital functions. It provides treatments for poisons that cause neurotoxic symptoms, such as loss of speech, motor failure, and respiratory distress. Nasal administration (*Nasya*) is used to deliver potent herbal extracts directly to the central nervous system to revive victims.

Astādhikāram (C8): Lepana Prakaranam (ಲೀಪನ ಪ್ರಕರಣಂ)

This chapter focuses on localized toxicity and the immediate physical trauma at the site of a bite or sting. It addresses inflammation, swelling, and localized necrotic effects caused by venomous fangs. The primary treatment method discussed is "Lepana," the application of medicated pastes and topical coatings to draw out toxins and prevent their systemic absorption.

Navamādhikāram (C9): Anjana, Pana Nasya Lepana Prakaranam (ಅಂಜನ ಪಾನ ನಸ್ಯ ಲೀಪನ ಪ್ರಕರಣಂ)

This chapter addresses severe, multi-systemic toxicity that requires the simultaneous application of all four major clinical procedures: drinks, eye drops, nasal drops, and topical ointments. It focuses on cases where the poison is so deep-seated or potent that a single route of administration is insufficient to save the patient. The text emphasizes the synergistic effect of combining these treatments for acute envenomation.

Dashamādhikāram (C10): Kshudrasarpa Vishāpaharanam (ಮಂಡಲಸರ್ಪ ಪ್ರಕರಣಂ)

This chapter specifically addresses the toxicity resulting from the bites of 19 varieties of "minor" snakes, primarily viper-like serpents known as Mandali. It details the specific symptoms associated with each type, such as localized rotting of the flesh, excessive bleeding, and high fever. The chapter provides unique diagnostic signs for these snakes, including the patterns of their body markings and the specific timing of their activity.

Ekādashādhikāram (C11): Vruschika Prakaranam (ವೃಶ್ಚಿಕ ಪ್ರಕರಣಂ)

Toxicity from the stings of scorpions is the sole focus of this chapter. It addresses the varying degrees of pain and systemic reactions caused by different scorpion species, categorized by their color and toxic potency. The chapter provides specific remedies, including fumigation and topical treatments, to neutralize the sharp, localized burning sensation characteristic of these stings.

Dwādashādhikāram (C12): Mooshikavisha Prakaranam (ಮೂಷಿಕವಿಷ ಪ್ರಕರಣಂ)

This chapter deals with the toxic effects of bites from 18 varieties of rats and mice. It addresses symptoms such as localized itching, fever, hair standing on end, and more severe systemic manifestations. The chapter lists nearly 45 different herbal remedies and fumigation techniques specifically designed to treat rodent-born toxicity.

Trayodashādhikāram (C13): Sarva Jangama Visha Prakaranam (ಸರ್ವ ಜಂಗಮ ವಿಷಮ ವಿಷಚಿಕಿತ್ಸಾ ಪ್ರಕರಣಂ)

This comprehensive chapter addresses toxicity from all other animate sources beyond snakes, scorpions, and rats. It covers the bites and stings of wild animals like tigers and bears, domestic animals like dogs and cats, as well as insects, spiders, and even human bites. Issues such as rabies ("*Penkuli*") and the toxic reactions to animal saliva and nails are explored in detail.

Chaturdashādhikāram (C14): Kritrima Vishachikitsā Prakaranam (ಕೃತ್ರಿಮ ವಿಷಚಿಕಿತ್ಸಾ ಪ್ರಕರಣಂ)

The toxicity issues in this chapter concern "artificial" or deceptive poisons known in Kannada as Kaimasaku or Maddaku. It addresses poisons deliberately introduced into food, drinks, or cosmetics, often causing chronic conditions, mental confusion, or slow systemic failure. The chapter details symptoms like digestive disorders, coughing,

and wasting diseases resulting from these hidden toxins.

Panchadashādhikāram (C15):

***Bhaspachikitsa Prakaranam* (ಬಾಷ್ಪಚಿಕಿತ್ಸಾ**

ಪ್ರಕರಣಂ)

This chapter addresses a unique toxicological concept involving "toxic vapors" or humors known as Bhaspa. It identifies 21 specific types of these toxic states, including Pitta Bhaspa and Krimi Bhaspa, which manifest through symptoms like internal burning, tremors, and metabolic disturbances. The chapter provides diagnostic criteria and specialized treatments to purge these toxic humors from the system.

Shodashādhikāram (C16):

***Sankeernādhikāra* (ಸಂಕೀರ್ಣಾಧಿಕಾರಂ)**

This miscellaneous chapter covers various remaining toxicological issues, including general detoxification and preventive medicine. It addresses environmental toxicity, such as identifying if a house or area is infested with venomous creatures, and provides methods to attract or expel them. The chapter also discusses the long-term management of recovered patients and techniques for testing if food or water has been contaminated.

Scope for research

KMD is currently in bookshelves of libraries, and hardly any attention is paid towards the contents and its practical usage. This can best be overcome by two routes. One, the contents should be brought to public information by putting it in a language easily understandable by common-man in their languages, upon which the required people put them to use just believing in the content. The second is research scholars who can bridge the gap traditional wisdom and evidence-based medicine. These scholars, a scope for at least 1000 scholars, to take up research on various issues of toxicity addressed in KMD to know the modern evidence-based practicality aspects and offer their findings for practice by public as applicable. Since KMD documents nearly 600 medicinal plants and over 150 combinations for treating Sthavara (inanimate) and Jangama (animate) poisons, which are the toxicity challenges society is facing, the second route is what the current paper is emphasizing on. In this context, some possible research questions are highlighted here, which could be taken as examples to formulate over thousand research questions.

Do the aqueous and ethanolic extracts of the *Chilla* plant (*Strychnos potatorum*), as described in the

Panadhikāra, exhibit significant neutralization of the enzymatic and lethal activities of *Daboia russelii* (Russell's viper) venom in vitro?

What are the specific phytochemical profiles and bioactive secondary metabolites of the herbs used in the *Krutantakudharashani Rasa* that contribute to its purported efficacy against systemic cobra envenomation?

Neuro-Acoustics and Psychosomatic Modulation
The *Garudamantradhikāra* emphasizes the use of specific auditory vibrations (Mantras) to stabilize a victim's mental state and induce a state of trance. Does the rhythmic repetition of the *Amrutadhara* and *Pakshiraja* mantras produce a measurable effect on autonomic nervous system parameters (heart rate variability, cortisol levels) in patients experiencing acute trauma or toxic shock? Hence, can the procedure of *Krosha Pataha Tadana* (beating drums near the ear) be analyzed as a form of sensory-evoked neural stimulation to assist in reviving victims of neurotoxic syncope?

Anjana (ocular) and *Nasya* (nasal) are two routes of administration of drugs which are not common in modern medicine; based on the primacy of the head in the human nervous system. Does the nasal administration (*Nasya*) of herbal preparations containing garlic and black pepper provide a faster route for bioactive compounds to bypass the blood-brain barrier compared to standard oral delivery during toxicological emergencies? Similarly, what is the permeation rate and systemic absorption profile (bioavailability) of the herbal-mineral coatings (*Lepana*) when applied to wounds using the *Kākāpāda* (crow's foot incision) method as a local stimulant for peripheral blood flow?

The *Kritrima Visha Prakarana* details poisons introduced through deceptive means, such as food contamination and physical contact. So the question arises as how does the clinical symptoms of artificial poisoning (*Kritrima Visha*) described in KMD correlate with modern diagnostic criteria for chronic heavy metal toxicity or environmental chemical exposure? Thus, can the antidotes for "*Kaitaka*" toxins, applied through kissing or skin contact, be validated for their efficacy in neutralizing modern industrial skin irritants or biological allergens?

Even the most "strange" treatments recommended in KMD can be analyzed for their biological potential. Thus, the question to be answered by research scholar is whether there a presence of specific microbial enzymes or chemical irritants in biological waste products (such as the excreta mentioned in the text) that could historically have acted as a chemical trigger for the respiratory centers in cases of severe neurotoxic paralysis? Thus, typically, does the application of sesame (*Tilaja*) to

eyes exposed to caustic Calotropis milk provide a surfactant effect that reduces corneal tissue damage? By addressing these questions through clinical trials and laboratory analysis, the Indian Knowledge Systems (IKS) can move from preservation to active scientific contribution.

Typical specific research questions:

When it comes to animate bites, the most common bites heard of are the dog bite, snake bite, honeybee bite and scorpion bites. However, KMD in chapter 13 suggests remedies for a number of bites (Table 1), all of which are worth researching on.

Table 1: Cases of animate toxicity for which neutralization is suggested in KMD, Chapter 13

Animate Toxicity Source	KMD verse reference
Tiger [ವ್ಯಾಘ್ರ / ಪುಲಿ]	13: 5–11
Lion [ಹರಿ (ಸಿಂಹ)]	13: 15
Wolf [ವ್ಯಕ (ತೋಳಿ)]	13: 15, 21
Jackal [ಗೋಮಾಯು / ನರಿ]	13: 47–48
Bear [ಕರಡಿ]	13: 18–19
Elephant [ಎಫ / ಗಜ / ಆನೆ]	13: 15, 61
Horse [ಅಶ್ವ / ಕುದುರೆ]	13: 12, 64
Wild Boar / Pig [ವಾರಾಹ / ಸೂಕರ / ಹಂದಿ]	13: 15, 20
Cow or Buffalo [ಅಮ್ಮಾವಿ / ಕೋಣ / ಗೋ]	13: 63, 74–75
Dog [ಕುಕ್ಕುರ / ನಾಯಿ ಮತ್ತು ಪೆಂಕುಳಿ]	13: 15, 24–46
Cat [ಬಿಡಾಲ / ಬೆಕ್ಕು]	13: 15, 49–51
Mongoose [ನಕುಲ / ಮುಂಗುಸಿ]	13: 12, 58–59
Rabbit [ಮೊಲ]	13: 78
Porcupine / Hedgehog [ಎಯ್ಯಿ]	13: 79–80
Monkey / Primate [ವಾನರ / ಮುಸು / ಸಿಂಗಳಿಕೆ]	13: 15, 59, 60, 62
Stag / Deer [ಕಡವು / ಮರೆ / ಹುಲ್ಲೆ / ಸಾರಂಗ]	13: 70–73
Wall Lizard [ಪಲ್ಲಿ / ಗೃಹಕೋಗಿಲೆ]	13: 90–95
Garden Lizard [ಓತಿ / ಸರತಿ]	13: 86
Chameleon [ಗೋಸುಂಬೆ]	13: 87
Monitor Lizard [ಉಡೆ]	13: 83–85
Crawling Lizard / Insect [ಪಾವರಣೆ]	13: 88–89
Crocodile / Shark [ಮಕರ / ಶಿಶುಮಾರ (ಮೊಸಳೆ)]	13: 96
Fish [ಮೀನೆ]	13: 97–100
Crab [ಏಡಿ / ಕುಲೀರ]	13: 101
Leech [ಜಿಗುಳೆ / ಜಲಾಶ]	13: 107
Frog [ಭೇಕ / ಕಡ್ಡೆ]	13: 102–106
Bee / Wasp / Swarming Insects [ಅಳಿ / ತುಂಬೆ]	13: 109–110
Hornet / Wasp [ಕಡೆಂದುರು]	13: 111

Animate Toxicity Source	KMD verse reference
Honeybee [ಜೇನನೋಣ]	13: 113
General Fly [ನೋಣ]	13: 114–116
Swarming Gnats [ನೋರಜು / ಗುಂಗುರು]	13: 124–125
Ant [ಇರುವೆ / ಕೆಂಜಿಗ]	13: 121–122
Bedbug [ತಗುಣೆ]	13: 121
Caterpillar [ಕೆಂಬಳಿಹುಳು]	13: 119
Specialized Worms / Insects [ಕೊಡಹುಳು / ಬಚ್ಚಹುಳು]	13: 120, 123, 126
Various Small Insects [ಕೀಟಕ (ವಿವಿಧ ಕೀಟಗಳು)]	13: 133–140
Bird Excreta [ಖಗಾಳಿ ಮೂತ್ರ-ವಿಷ್ಣು (ಪಕ್ಷಿಗಳ ಮಲಮೂತ್ರ)]	13: 108
Human Bites / Scratches [ಮನುಜ ದಂತ-ನಖ (ಮನುಷ್ಯನ ಹಲ್ಲು ಮತ್ತು ಉಗುರು)]	13: 128–131

Consider a typical case, arbitrarily, of Monitor Lizard toxicity. Modern literature does not give any specific neutralizer (Vikrant *et. al.*) KMD in three verses 83–85 of chapter 13, give three types of suggestions for its neutralization; namely pāna, lepana and anjana; meaning, for internal consumption, external application and eyebrow application respectively. The three verses are as follows:

"ಭಲ್ಲಾತಕ ತರುಮೂಲಂ ಸಲ್ಲಿತ ಗುಡೂಚಿ ಭದ್ರಮುಸೆಯಿವಂ
ತಾಂ |
ನಿಲ್ಲದೆ ನೀರಿಂ ಕುಡಿಯಲ್ ನಿಲ್ಲದು ಹೇರುಡುಗಳಗಿದು ತುಡುಕಿದ
ಗರಳಂ"
"Bhallātaka tarumūlaṁ sallita guḍūci
bhadramuseyivam tāṁ |
nillade nīriṁ kuḍiyal nilladu hēruḍuḡaḷagidu
tuḍukida garaḷaṁ".

(KMD, 13: 83)

This verse suggests a medicated drink. It means as follows. To neutralize the fierce venom of a monitor lizard, grind the root of the marking nut tree (*Bhallataka*), heart-leaved moonseed (*Guduchi*), and nut grass (*Bhadramuste*) in water and give it to the victim to drink.

The therapeutic mechanism for neutralizing monitor lizard toxicity through this verse could be through the synergistic action of Bhallataka (*Semecarpus anacardium*), Guduchi (*Tinospora cordifolia*), and Bhadramuste (*Cyperus rotundus*) ground in an aqueous medium. Monitor lizard bites are clinically significant for causing severe localized infection and systemic sepsis due to the complex bacterial flora in their saliva; therefore, the inclusion of *Guduchi* could provide essential immunomodulatory and anti-inflammatory support to stabilize the victim's metabolic response. *Bhadramuste* is known to act as a potent detoxifier that aids in blood purification, while the root of *Bhallataka* is traditionally valued for

its deep-tissue penetration, likely working to neutralize necrotic enzymes and prevent the systemic spread of the venom.

"ಕನಕದ ರಸಮುಂ ಗರ್ದುಗುಂ ಜನಹಿತಕರಮೆನಿಸಿ ಪರ್ನಿದೆಯ್ಲೆ

ನಾಗಂ |

ಸುನಯದಿನರೆದು ವಿಲೇಪಿಸ

ಲ್ಮನುಪಮಮೆನಿಪುಡುಗುಗ್ರವಿಷಮದು ತಿಳಿಗುಂ"

"Kanakada rasamuṃ garduguṃ janahitakāramenisi
parṇideydele nāgaṃ |
sunayadinaredu vilēpisa
lmanupamamenipuḍuḡaḡraviṣamadu tiḷigum".

(KMD, 13: 84)

This verse suggests an ointment. It means as follows: To clear the intense toxicity, prepare a paste by grinding the juice of the Datura plant (*Kanaka*), bonduc nut (*Gardugu*), and the leaves of the "five-leafed Naga" plant, then apply it as an ointment to the site of the bite.

The therapeutic mechanism of the *Lepana* (ointment) described here might focus on countering the localized tissue destruction and rapid infection characteristic of a monitor lizard (*Uda*) bite. By grinding the juice of Datura (*Kanaka*), Bonduc nut (*Gardugu*), and the leaves of the "five-leafed Naga" plant (botanical equivalent to be researched), the combination could create a potent biochemical barrier at the site of envenomation. *Caesalpinia bonduc* (Bonduc nut) is traditionally valued for its antiseptic and anti-inflammatory properties, which directly target the complex bacterial flora found in reptilian saliva to prevent systemic sepsis. Furthermore, the alkaloids in the Datura juice likely could act as local modulators to suppress the enzymatic breakdown of tissue, thereby stabilizing the wound and preventing localized necrosis from progressing into the circulatory system

"ಅತಿಬಜೆ ಕರ್ಪುರ ಗುಂಜಾನ್ವಿತಮಪ್ಪಭಯಂಗಳೆಂಬಿವಂ

ಪಾಲಿಂದು |

ಯತಮಾಗೆ ಕಣ್ಣೆಳಿಚ್ಚಿ ಲ್ಪುತಿಮಮೆನಿಪುಡುವಿನುಗ್ರ

ವಿಷತತಿಯಚ್ಚುಗುಂ"

"Atibaje karpura guṇjānvitamappabhayaṅgaḷembivam
pālindu |

yatamāḡe kaṇṇollicca lṛtīmamenippuḍuvinuḡra
viṣatatiyacchaguṃ"

(KMD, 13: 85)

This verse suggests eyeliner application. It means as follows. To destroy the severe spread of the venom, grind sweet flag (*Atibaje*), camphor, rosary pea (*Gunja*), and myrobalan (*Abhaya*) in milk and apply the mixture to the eyes as a medicated collyrium.

The possible therapeutic mechanism of the *Anjana* described here focuses on the rapid systemic and

neurological stabilization of the victim. By grinding Sweet Flag (*Atibaje*), Camphor (*Karpura*), Rosary Pea (*Gunja*), and Myrobalan (*Abhaya*) in milk, the remedy could use a lipid-based vehicle to enhance the absorption of bioactive compounds. Monitor lizard bites are clinically associated with severe sepsis and potential neurotoxic effects; the ophthalmic route is traditionally employed in *Vishavaidya* to provide a direct pathway for medicinal metabolites to protect the central nervous system and vision. The aromatic and neuro-modulatory properties of ingredients like *Acorus calamus* (*Atibaje*) likely work to counter the "severe spread of venom" (ಉಡುವಿನುಗ್ರ ವಿಷತತಿ) by inducing rapid cortical arousal and systemic detoxification

Considering the possible research methodology for the three verses, the following propositions can be made.

The first step in the research, not only for the three verses, but any of the verses is the botanical standardization of the material or the herb. Next would be to employ LC-MS/MS phytochemical profiling to identify the specific metabolites that contribute to the formula's property to combat the particular pathogen.

With respect to pāna, (KMD, 13:83), modern research could employ in vitro enzymatic inhibition assays to test the extract's ability to halt tissue-degrading enzymes and in vivo animal models to conduct LD50 shift assays, measuring the formula's systemic efficacy in increasing survival rates after envenomation. Finally, a histopathological review of vital organs and the bite site would be necessary to confirm if the formula effectively prevents the rapid progression of sepsis and localized necrosis typical of such animal bites

With respect to *lepana* (KMD, 13:84) scientific validation could start with in vivo animal modelling, where the *lepana* is applied to standardized bite wounds to monitor its ability to halt tissue degradation via histopathological reviews of the site. Additionally, transdermal absorption studies can be used to measure how effectively the medicinal compounds penetrate the skin to neutralize localized toxins, providing a translational evidence base.

For scientific validation researchers could then employ In Vivo bioavailability assays using animal models to measure the concentration of medicinal markers in the bloodstream and cerebrospinal fluid, specifically comparing the speed of absorption via the ophthalmic route versus standard oral administration. Furthermore, specialized trans-barrier studies could be conducted to determine if the lipid medium (milk; by default, meaning Bos-Indicus milk) effectively assists these herbal compounds in bypassing the blood-brain barrier to

mitigate neurotoxic damage. Further, the study could assess the synergistic role of the *Anjana* within the holistic "*Pana-Lepana-Anjana*" framework to see if its inclusion results in a statistically significant reduction in systemic sepsis and recovery time.

The three methods, being working in different routes, perhaps could be complementary to each other. Thus, even simultaneous use of the three is also worth studying, which could hasten the action; is also worth studying.

Yet another interesting possible research from chapter 4 of KMD is given in brief here. This compelling example for research is based on verse 4:49 (an arbitrary verse) of KMD reads as follows:

"ಕ್ರಮದೋಂ ನಮೋ ಭಗವತಿ ಪ್ರಮುಖಾಕ್ಷರಮಂ ಜಪಂಗೆ |ಯಲ್ ಸೀಂ|

ನೂಟಂ |

ಟಮರ್ಬರೆ ಬಜಿಯಂ ತಾಡಿಸು |

ಡಮರುಗಮಂ ದಷ್ಟಪಾಶ್ಚದೋಕ್ ಸಾಕ್ಷೋಶಂ"

kramadoṃ namō bhagavati pramukhākṣaramaṃ japaṅge
[yal nīṃ] nūḷiṃ | ṭamardire baḷiyam tādīsu |
ḍamarugamaṃ daṣṭapāśvadoḷ sākrośaṃ

(KMD, 4:49)

This means, "The physician is instructed to chant the *Namo Bhagavati* mantra 108 times while simultaneously beating a drum (*damaruga*) near the ear of a victim who has fallen into a toxic coma from a snake bite." The goal is to "awaken" or revive the patient using high-decibel acoustic and vibrational triggers.

Modern validation of this protocol involves the systematic application of Neuro-Acoustic Spectral Analysis to perform a Fast Fourier Transform (FFT) on the rhythmic, high-decibel drumming of the *damaruga* and the 108 repetitions of the *Namo Bhagavati* mantra to identify frequencies that may trigger cortical arousal in victims of neurotoxic paralysis. By monitoring objective clinical markers such as EEG brainwave patterns and Heart Rate Variability (HRV), the protocol seeks to quantify how these traditional vibrational triggers stabilize the Autonomic Nervous System and potentially stimulate neural pathways to awaken a patient from a toxic coma. This methodology aims to bridge Mangaraja's esoteric "*Mantra Chikitsa*" with contemporary evidence-based medicine, investigating whether sensory-evoked neural stimulation can function as a viable resuscitation limb within a holistic clinical framework.

While many such examples can be given, only a couple of them is considered in order to say the scope for research on KMD which is virtually endless.

Conclusion:

Khagendramani Darpana stands as a monumental but largely unexplored repository of 14th-century toxicological wisdom, bridging ancient Indian Knowledge Systems with potential modern scientific applications. Its systematic documentation of intricate herbal-mineral formulations; presents a vast field for phytochemical and pharmacological research into identifying novel bioactive compounds for anti-venom therapy.

The scope for research extends beyond pharmacology into the realms of neuro-acoustics and psychosomatic medicine, where the text's elaboration on *Mantra Chikitsa* (such as the *Amrutadhaba* mantra) and sensory-stimulation procedures (like *Krosha Pataba Tadana*) offers unique data for studying autonomic nervous system modulation. Additionally, the text's emphasis on specialized administration routes like *Nasya* (nasal) and *Anjana* (ocular) provides a historical basis for investigating trans-barrier drug delivery systems in medical emergencies.

Ultimately, the transition of this text from a literary treasure to a modern research subject requires translational inquiry and rigorous clinical validation. By applying contemporary methodologies to its protocols for managing *Jangama* (animate), *Sthavara* (inanimate/stationary), and *Kritrima Visha* (artificial poisons), the scientific community can fulfill Mangaraja's noble philosophy of *sarvajanopakāra*—ensuring that this "unexplored treasure" contributes effectively to global public health and evidence-based medicine.

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