Ilam University of Medical Sciences

Plant Biotechnology Persa

Online ISSN: 2676-7414

Homepage: https://pbp.medilam.ac.ir

Science of toxicology in Rabban Al-Tabari's Paradise of Wisdom: a review

Mohammad Amrollahi-Sharifabadi[1], Jamal Rezaei Orimi[2,3], Mohammad Kamalpour[4]

[1]Department of Basic Sciences, Faculty of Veterinary Medicine, Lorestan University, Khorramabad 68151-44316, Iran. Email: amrollahi.m@lu.ac.ir
[2]Pre-hospital Emergency Medical Services and Disaster Management Center, Mazandaran University of Medical Sciences, Sari, Iran. E-mail: Rezaei.history93@gmail.com
[3]Department of Persian Medicine, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran.
[4]Department of Basic Sciences, Faculty of Veterinary Medicine, Lorestan University, Khorramabad 68151-44316, Iran. Email: kamalpour.m@lu.ac.ir

Article Info

Article type:
Review Article

Article History:
Received: 21 Jan 2023
Received in revised form: 07 March 2023
Accepted: 20 December 2023
Published online: 01 July 2023

Keywords:
Toxicology, History, Persian Traditional Medicine, Medieval, Poisoning

Abstract

As an important threat throughout history, poisonings have plagued mankind from ancient times to today. This review intended to answer the question that whether toxicology and intoxications have been addressed in the one of the oldest medical texts of traditional Persian medicine; Al-Tabari's Paradise of Wisdom and whether there had been a specific approach to manage poisonings. Extensive research was conducted in Al-Tabari's book Firdausu'l-Ḥikmat also known as Paradise of Wisdom using toxicology related keywords. Moreover, current literature was searched with relevant keywords using Web of Science, Science Direct, Embase, PubMed, Google Scholar, MagIran, IranMedex, and SID to adapt the data with modern toxicological knowledge. Our result revealed that Al-Tabari described the toxicity and pertinent treatments for *Nerium oleander* L, *Papaver somniferum* L, *Aconitum ferox* Wall, *Euphorbia serrata*, *Anamirta paniculata*, *Semecarpus Anacardium*, *Brassica oleracea*, *Coriandrum sativum*, *Hyoscyamus albus*, and *Colchicum autumnale* L. He indicated the toxicity of the winds that blowing from areas with toxic pollen and scent of plants. Also, he mentioned the toxicity of snakes, scorpions, spiders, bees, and rabid animals as well as the hazardous creatures including Mus musculus and Lytta vesicatoria along with some descriptions for related treatments. At the end, Al-Tabari reckoned the toxicology and treatments of some toxic minerals including mercury, iron, and lead. Conclusively, Al-Tabari contributed to toxicological sciences though dedicating a proportion of his book Paradise of Wisdom to the subject of toxicants and poisoning therapeutics. Further studies are recommenced to divulge toxicological science in historical sources including traditional medical works.

[DOI: 10.61186/pbp.6.1.10]

Publisher: Ilam University of Medical Sciences
How to cite: Amrollahi-Sharifabadi M, Rezaei Orimi J, Kamalpour M. Science of toxicology in Rabban Al-Tabari's Paradise of Wisdom: a review. Plant Biotechnology Persa 2023; 6(1): 10-19.

Introduction

Throughout history, humans have always been at risk of encountering poisonous plants and animals in their surroundings. Due to the amazing advances in agriculture, pharmacology, and industrial technology, humans are more expected to expose to toxic industrial chemicals and pesticides in the modern world [1, 2]. However, cases of exposure to poisonous plants and animals are still considered to be among major health issues [3-5]. Cases of poisonings with plants and animal envenomings are still among of the most important issues that threaten human health and life, monopolizes a large proportion of hospital admissions, causes many deaths around the world annually, and imposing huge costs on healthcare systems [6, 7]. On the other hand, traditional Persian medicine can be considered as informative sources of medical sciences including toxicology and poisonings [8-10].

Among outstanding sources of traditional Persian medicine and one of the oldest medical works in this field, is the book Firdausu'l-Ḥikmat also known as Paradise of Wisdom which is authored by Abul Hasan Ali Ibn Sahl Rabban Al-Tabari shortly known as Rabban Al-Tabari (Circa 838-870 A.D) [11]. He is a famous Persian physician and pharmacist of the 9th century CE and regarded as one of the major medieval Iranian and the Islamic Golden Age scholars [12]. He was born in Tabaristan, Iran (today's Mazandaran) and died in Iraq [13]. His book; Paradise of Wisdom was edited by Mohammad Zubair Al-Sadiqi on the recommendation of Edward Brown and published in Berlin in 1928 [12, 14]. Firdausu'l-Ḥikmat is written in seven parts, thirty sections (Al-Maghalat meaning articles), and three hundred and sixty chapters (Al-Bab) in the form of a complete course for sciences such as medicine [15]. In addition to medicine, this textbook contains other disciplines including agriculture, meteorology, geology, anthropology, zoology, and botany [11]. Al-Tabari used the notion of precedent scholars such as Hippocrates, Galen, Aristotle, Ibn Masuyeh, and Hanin Ibn Ishaq as well as Indian scholars during the preparation of this book [16, 17]. Considering the medical legacy of traditional Persian medicine textbooks that are rich in valuable medical knowledge including toxicology, in this contribution, we aimed to answer the question whether the Paradise of Wisdom was addressed toxicological sciences and therapeutic approach for poisoning.

Materials and Methods

The current study was a narrative historical review probing toxicologically related keywords on the Arabic and Persian versions of the Al-Tabari's book Paradise of Wisdom to elucidate the available data on the toxicological science [17]. Searched keywords constituted "Sam, Masmoumiat, Giahan-e-sami, Gazesh, and Nish" in Persian; "Al-Sam, Al-Sumum, Al-sumum Al-Nabatiah, Al-Nahsh, Al-Lazei in Arabic, that were English equivalents of "poison, poisoning, poisonous plants, envenoming, sting or bite". Moreover, we searched the indicated keywords using available literature in Science Direct, Web of Science, Embase, PubMed, Google Scholar, SID, Magiran, and IranMedex to adapt the historical data with modern knowledge. The inclusion criteria comprised valid literature of original articles and reviews while we excluded case reports as well as other unrelated study designs. Finally, the obtained contents were carefully reviewed and analyzed to present in this contribution.

Results

In the fifth article (Al-Maghale Al-Khamseh) of Firdausu'l-Ḥikmat, Al-Tabari (figure 1) provided the knowledge of toxic materials in two main sections. The first section described characteristics of toxicants (Al-Bab Al-Awal Menha Fi Al-Sumum), and the second section presented symptoms, and treatments of poisonings (Al-Bab Al-Thaani Fi Ealamat Al-Sumum Wa Elajuha) [17]. At first, he divided poisons into three main classes of toxic plant, animals, and minerals (Table 1). Al-Tabari described the toxicity and treatments for poisonous plants including *Nerium oleander* L, *Papaver somniferum* L, *Aconitum ferox* Wall, *Euphorbia serrata*, *Anamirta paniculata*, *Semecarpus Anacardium*, *Brassica oleracea*, *Coriandrum sativum*, *Hyoscyamus albus*, and *Colchicum autumnale* L. Also, he mentioned the toxicity of the winds (Al-Riah Al-Samum meaning toxic winds) that blow from areas entailed pollen and the scent of poisonous plants [17]. He also explained about the poisonous animals including snakes, scorpions, spiders, bees, and rabid animals as well as the noxious

[DOI: 10.61186/pbp.6.1.10]

creatures such as *Mus musculus* and *Lytta vesicatoria* and addressed the treatments. Then, Al-Tabari indicated the toxicity and treatments for minerals including mercury, iron, and lead [17].

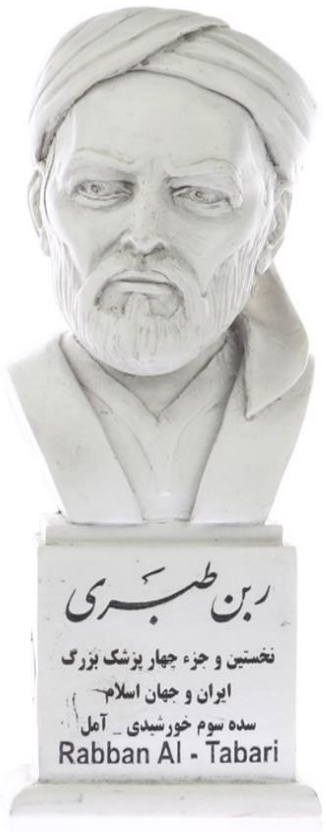

Figure 1. *Sculptured head of Ali Ibn Sahl Rabban Al-Tabari (Circa 838-870 A.D), Courtesy of The Mohammadi's Tandis Shahriar, Tehran, Iran.*

Table 1. *Comprehensive analysis and review of toxicological knowledge in Rabban Al Tabari's Paradise of Wisdom*

Categorization of poisons and diagnosis of poisonings			
	Toxic plants Poisonous animals Toxic minerals		
Poisonous plants in Al-Tabari's Paradise of Wisdom			
Traditional name	Common name	Scientific name	Al-Tabari's data
Alsam Alhemar	Oleander	Nerium oleander L	It is deadly for humans and animals and kills insects as well.
Alafyun	Opium poppy	Papaver somniferum L	The gum of the plant called opium. It makes the body cold. It numbs the body and joints, induces sleep, and stops the blood. If we rubbed the skin of a patient who has eaten opium, the smell of opium will rise from the body.

[DOI: 10.61186/pbp.6.1.10]

			Treatment included inducing nausea by consuming a mixture of vinegar, oil, dill juice, and honey after cooking them. Dill juice can also be used as an enema for an additional treatment.
Albesh	Monkshood	Aconitum ferox Wall	For treatment, it is recommended to eat turnip seeds cooked in wine and cow's oil.
Alfarbuon	Spurge	Euphorbia serrata	The symptom of poisoning is that it makes the mouth bitter, darkens the vision, and makes the hands and feet cold because the blood makes the heart cold. Its treatment is included inducing nausea with dill juice, and it is also beneficial to eat chamomile (Matricaria chamomilla,) and Assyrian plum (Cordia myxa) with honey. Consumption of opium and sulfur mixed with wine is useful for treatment.
Alsam Alsamak	Indian berry	Anamirta paniculata	When it is poured into the water, dead fish appear in the water surface.
Albaladhur	Marking nut	Semecarpus anacardium	It is toxic.
Alkurnb	Cabbage	Brassica oleracea	If this plant is placed next to the person who is speaking, his/her voice and strength will be greatly reduced.
AlKazbara	Coriander	Coriandrum sativum	It freezes the blood, lowers a person's voice, and destroys his wisdom (neurotoxicity). Its treatment included to take boiled dill juice mixing with vinegar and wine to induce nausea.
Albanj Al'abyad	White henbane	Hyoscyamus albus	The symptom of poisoning is that the person gets drunk and his/her cheeks turn red. The treatment included to drink water mixed with honey and cow's milk, and give the patient boiled horseradish (Armoracia rusticana) juice to make him vomit, and prescribe oral opium.
Alsuranjan	Colchicum	Colchicum autumnale L	It is fatal.
Alfutryat	Mushrooms	Amanita phalloides Amanita muscaria	Some species are deadly for human. Its treatment included to consume dill j juice with cow oil and vinegar oil to induce vomiting. It is also useful to eat grape branch ash mixed with vinegar and salt to induce emesis.
Traditional name	Common name	Scientific name	Al-Tabari's data

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Alfar	House mouse	Mus musculus	If a patient wounded for example by combating with a wild animal, then he should care his/her injured skin and prevent contacting with mouse's urine, if so he/she will die.
Venomous animals (snake, scorpion, spider, and bee)			Useful treatments included eating Commiphora opobalsamum and Ferula assafoetida L. in cases of snake and scorpion bites. Walnut jam is useful for scorpion stings. Consumption of fawn's rennet is useful for snake bites. Local treatments involves mixing honey with wine and puting on the snake bite site. Topical usage of sulfur is useful in snake bites and other insect envenomings. Sheep and goat butter is useful for snake bites.
Pigeon waste			If food is contaminated with pigeon droppings, eating it may lead to dying in humans and animals.
Aldhuraah	Spanish fly	Lytta vesicatoria	When it reaches the bladder, it causes a lot of burning and causing the blood and flesh to flow from it, resulting in blurred vision and even loss of vision. Eating ram's meat is its antidote. The treatment is to mix boiled dill juice with cow oil and drink it to induce vomiting. Soak in tepid water and apply vinegar oil is udeful. Flax seeds and milk are also useful.
Rabid animals (dog, fox, mouse, and mule)			If a rabid dog bites someone, the person will not be able to look at the water and will die of thirst, and some substances will be seen in her urine. A fox or even a mouse may become rabid; I have heard that a mad (rabid) mule, bit its rider and killed him.
Toxic minerals in Al-Tabari's Paradise of Wisdom			
Traditional name	Common and scientific name	Al-Tabari's data	
Alziybaq	Mercury	It is toxic to human. In a power, it is useful as a rodenticide.	
Alnijarat alsulb	Iron shavings	If the patient has eaten it, he/she should mix a small amount of a powder of magnetic stone with water twice a day, morning and night, and then eat it and vomit. After that, drinking goat's milk is udeful.	

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Alrasas	Lead	The treatment is to induce vomiting with dill juice and cow oil. Drink the juice of celery seeds and pepper, which is prepared by mixing equal parts of the two mentioned items with a part of myrrh (Commiphora myrrha) and mixing it with wine and drinking it as much as a Mithqal (~4.2 g) with water.

\Discussion

Our data reveled that Rabban Al-Tabari contributed to the toxicological science by writing the fifth article (Al-Maghale Al-Khamseh) of Firdausu'l-Ḥikmat. In detail, he categorized toxic substances into three main domains entailing plants, animals, and minerals. He described common toxic plants, animals, and minerals in several paragraphs and then he outlined the signs and symptoms for the diagnosis and treatment. Finally, he proposed relevant therapeutic agents and antidotes to treat poisonings [17]. This data is in agreement with modern toxicological science as toxic plants regarded as phytotoxins, animal poisons named zootoxins, and toxic minerals addressed in the title of toxic heavy metals and minerals [18, 19]. However, in modern toxicology, poisonous plants also classify based on their active substances. For example, plants including tropane alkaloids (*Datura* spp. and *Hyoscyamus albus* seeds), cardiac glycosides (e.g. *Nerium oleander* L), toxalbumins (licorice and castor), opioid alkaloids (e.g. *Papaver somniferum* L), as well as plants containing anti-microtubules (*Colchicum autumnale* L), amongst others [20]. Poisonous materials including toxic plants can also be classified into different classes considering their impacts on the human organs [21]. The exposure route with toxic plants can occur by ingestion, while the poisonous animals can delivered their toxins via their stings or other ways [22]. Our research showed that the Persian physician and medical scholar Ali Ibn Sahl Rabban Al-Tabari had an authority on clinical toxicology and treatment of poisonings at that time that was reflected in his work Firdausu'l-Ḥikmat. However, it can be assumed that the pattern of poisonings in medieval times, including the era of Islamic Medieval Golden Age, the time of Al-Tabari's living, was mostly plant and animal poisonings, supposedly because at that time there were less industrial chemicals and pesticides. But today, considering that most treatments are based on modern medicines, it would not be far from expectation if the pattern of poisonings are different from medieval times when we have lots of poisoning cases with generic medicines [23, 24]. Nevertheless, plant poisoning and animal bites are still considered amongst risks to human health [25, 26].

Although there is no comprehensive and complete classification in relation to all poisons even to this day, scholars have been always tried to categorize poisons according to specific criteria. Poisons may be classified based on physical state (liquid, gas and powder); extend of chemical reactivity or stability (corrosive, flammable, and explosive); general chemical structure (halogenated hydrocarbon, aromatic amine, and etc.); capability to induce toxicity (extremely, highly, very, moderately, rarely toxic, and virtually nontoxic); biochemical mechanisms of action (e.g., alkylating agents, cholinesterase inhibitors, disturbance in endocrine gland function); and effects such as irritation, or oxidant properties [27]. According to some historical texts related to toxicology, poisons were categorized into 1- first class: corrosive poisons; 2- second class: astringent poisons; 3- third class: acrid (pungent and smelly) poisons; 4- fourth class: asphyxiating poisons; 5- fifth class: narcotic poisons; and 6- sixth class: septic poisons [28]. Other scholars were categorized poisons based on identification and detection techniques used in the laboratories [29, 30]. Also, toxicants can be categorized based on their adverse effects on organs introducing specific toxicological areas such as cardiovascular, neurological, respiratory, renal, gastrointestinal, and liver toxicology as well as reproductive toxicology and teratology [27]. Nonetheless, today's classifications of poisons are still descriptive and general such as air pollutants, occupational and environmental toxic chemicals, or agents that can cause acute or chronic poisonings, or those that can cause specific toxic syndromes, or agents that have similar signs and symptoms [31, 32].

[DOI: 10.61186/pbp.6.1.10]

Perhaps one of the reasons why old scientists like Al-Tabari were interested in studying and classifying harmful and toxic substances, was the relatively small number of those substances and compounds compared to the infinite number of toxic compounds we encountering with them today. Poisoning with various substances and compounds is still one of the health problems causing morbidities and mortalities [33]. We elucidated that Al-Tabari had the knowledge about various poisons, and classified them accordingly [34]. Similarly, modern toxicology literature have specified methods of diagnosis and treatment of acute and chronic poisoning with various toxins, from poisonous plants to animal envenomings to heavy metals [35, 36]. According to modern toxicology, toxic compounds can be classified based on their physical state, degree of chemical stability or reactivity, chemical structure, potency, and mechanisms of action [27]. Furthermore, in modern human and veterinary toxicology literature, three categories of plant, animal, and mineral toxins are studied separately in different sections [18]. In the current medical textbooks, poisonings also described and classified, which are including alcohol poisoning, drug poisoning, food poisoning, insecticide and pesticide poisoning, opioid poisoning, herbal poisoning, and envenomings [37]. Generally speaking, the mentioned poisonings occurred by oral or injection. Similarly, according to our results, Al-Tabari mentioned that poisonings are induced via ingestion (plant, animal and mineral) or injection (bites and stings). Importantly, the epidemiological modern studies indicate that the ingestion or oral route is the main way of toxic exposures [38]. Therefore, the prevalence of oral poisoning is believed to be common both in traditional Persian medicine and modern medicine.

It may be assumed that the toxicological science can be traced in other Persian medicine resources. There are several books were written on this topic specifically that are included "Al-Somum Va Daf-e Mezaraha" (Toxins and elimination of their harms) by Jabir ibn Hayyan (8th century A.D), "Al-Monghez Men Al-Halakat Fi Dafe Al-Samum Al-Mohlekate" by Hussein Ibn Abi Thalaba Ibn Mubarak Tabib (11th century AD), "Al-Resalate Al-Fazelie Fi Al-Sumum" by Abu Omran Obeid Mosa Ibn Meimon Ghortabi, "Al-Samum Liariqa" by Ibn Wahshiyah Chaldani (9th century A.D) and "Al-Marifah-on Fi Dafe Al-Sumum Wa Hefz Al-Sehe" by Badra Al-Din Muhammad Qusuni (16th century A.D) [39-42], just to name a few. Working on the toxicological information in the mentioned texts can be an informative niche for both the history of medicine and the history of toxicology. Poisonings and envenomations by animals can be happened by either bites and stings of animals or consumption of poisonous ones [27]. These diseases can be caused by snakes, scorpions, spiders, bees, domestic and wild animals (dogs, monkeys, leopards, and wolves), as well as poisonous marine animals, and various types of insects [43]. Presumptively, Islamic Persian scholars may be described these matters in their works such as "Al-Haywan" by Jahez, "Ajayeb Al-Makhloghat Wa Gharaeb Al-Mojodat" (Wonders of creatures and the strangers of creatures) by Qazvini, and "Hayat Al-Haywan Al-Kubra" by Damiri [44-46]. Therefore, it is recommended to investigate and analyze the contents of medicine and toxicology in the aforementioned books in future studies.

Conclusion

Our study highlighted the seminal contribution of Ali Ibn Sahl Rabban Al-Tabari (Circa 838-870 A.D), to toxicological science by allocating a proportion of his medical book Firdausu'l-Ḥikmat also known as Paradise of Wisdom to this subject matter. In the fifth article of Firdausu'l-Ḥikmat namely Al-Maghale Al-Khamseh which were composed of two subsections Al-Bab Al-Awal Menha Fi Al-Sumum and Al-Bab Al-Thaani Fi Ealamat Al-Sumum Wa Elajuha, Al-Tabari discussed in details on toxicology. Further studies are recommended to scrutinize other aspects of the history of toxicology in medieval Islamic works including traditional Persian medicine books as valuable sources for this area of research.

Conflict of interest

The authors declare that they have no conflicts of interest.

Authors' contributions

Conceptualization: Mohammad Amrollahi-Sharifabadi; Methodology, validation, analysis, investigation, and resources: Mohammad Amrollahi-Sharifabadi, Mohammad Kamalpour, Jamal Rezaei Orimi; Data curation, original draft preparation, editing, and reviewing: Mohammad Amrollahi-Sharifabadi, Jamal Rezaei Orimi, Mohammad Kamalpour; Visualization, supervision, and project administration: Mohammad Amrollahi-Sharifabadi, Mohammad

[DOI: 10.61186/pbp.6.1.10]

Kamalpour, Jamal Rezaei Orimi. All authors read and approved the final version of the manuscript.

Funding

None.

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