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Original Article

A Study on Arsenic and Arsenic-Containing Mineral Medicines Referenced in Ancient Books of Traditional Mongolian Medicine

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ABSTRACT

Introduction: Arsenic was used to distinguish between red stone poison and white stone poison in traditional medicine from ancient times. However, there is no specific study conducted on "stone arsenic" based on ancient Mongolian medical books and manuscripts. Therefore, this study aims to collect and analyse information on arsenic recorded in ancient traditional medical scriptures and books written in Mongolian and Tibetan as early as the 19th to late 20th centuries, with a focus on its medical applications and associated terminology. **Methods:** The hermeneutic research method emphasises the interpretive analysis of ancient texts, communications, and their interrelations. Employing the hermeneutics method, we focused on interpreting the meanings within ancient medical texts and manuscripts, including the terminology of the sources selected for analysis. The checklist method was used to categorise and list the facts and information about arsenic in the study sources. The relevant components of the collected information and facts regarding arsenic and arsenic-containing mineral medicines were examined. **Results:** Several sources of traditional Mongolian medicine have mentioned the use of arsenic as a standalone substance. Additionally, there is limited information about its use in combination with other medications. During the research, it was discovered that an ancient manuscript mentioned its use as an active ingredient. This manuscript, a single-page scripture, is poorly written but contains rare information. The active ingredient of this medicine is arsenic, and the other four ingredients are sulphur native, sal ammoniac, realgar, and resin of the plant Shorea robusta. It is mixed with aged oil and applied to various wounds, and is regarded as one of the most effective remedies for all ulcers and wounds. **Conclusion:** The research results revealed that there are several clear references to arsenic in ancient traditional Mongolian medical books and manuscripts written in Tibetan and Mongolian. The Tibetan name for arsenic is *rdo dug*, the Mongolian name is khüntsel, and the Latin name is Arsenicum. The findings indicate that arsenic is incorporated into several traditional prescriptions and serves as an active component in certain medicinal formulations.

Keywords: Arsenic, mineral medicines, traditional medicine, ingredient, manuscript

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INTRODUCTION

Arsenic has a long history of being used as a poison, a therapeutic agent, and a cosmetic[1,2,3,4]. In particular, As_2O_3 and realgar (As_4S_4) have been constituents of traditional Chinese medicine for over 2000 years and remain to be used in medicine under strict regulations today[5,6]. To date, the traditional Chinese medical practitioners still prescribe arsenic in medications for asthma, rheumatoid diseases, syphilis, and psoriasis[7]. Concurrently, the emergence of the As_2O_3 drug has made a great turning point in Acute promyelocytic leukemia (APL). Acute promyelocytic leukemia is no longer a dreadful malignancy but highly curable[8]. In addition, there are some facts written about arsenic and arsenic-containing minerals in ancient traditional Mongolian medicine books and manuscripts. Arsenic-containing realgar is bitter, has a hot taste, a warm and heavy quality, and is toxic. It has been used to promote wound healing, reduce lymphatic swelling, treat malignant glandular growths, and address bacterial infections and infectious fevers. It has been regarded as one of the most effective remedies for diphtheria. Arsenic, mercury, and Wolf's bane (aconite) are powerful poisons that are lethal to humans, but if their toxicity is properly attenuated and used in medicine, they can become truly beneficial medicinal substances. However, it is extremely poisonous. Specifically, arsenic trioxide (As_2O_3) was historically used in the killings of many kings, earning the title "Poison of Kings" [9]. In Mongolia, ancient doctors and maarambas referred to arsenic using the Tibetan term *rdo dug*, which literally translates to "stone poison" in Mongolian[10,11], and the common term is arsenic. Knowledge of arsenic in Mongolia is not new. A traditional proverb captures this understanding: "If you speak ill of a person, his words will come back to you; if you eat arsenic, your teeth will be broken". The proverb implies that those who speak ill of others ultimately harm themselves, as their malicious words return to haunt them. Natural arsenic was extracted from "stone poison" and from realgar. Arsenic was used to distinguish between red stone poison and white stone poison[12]. However, there is no specific study conducted on "stone arsenic" based on ancient Mongolian medical scriptures. Therefore, this study aims to collect, analyse, and summarise information related to arsenic from traditional Mongolian medical manuscripts and books written in both Tibetan and Mongolian languages.

RESEARCH PURPOSE

To collect and analyse information on arsenic recorded in ancient traditional medical books and

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manuscripts written in Tibetan and Mongolian, with a focus on its medical applications and associated terminology.

RESEARCH MATERIALS AND METHODS

1. We used the following ancient medical scriptures as the main sources for our research:

- Toin Jambaldorj (Mongolian). "Gso byed bdud rtsi 'khrul med ngos 'dzin bzo rig me long du rnam par shar pa mdzes mtshar mig rgyan zhes bya ba bzhugs so." Woodblock printed and written in Tibetan between 1817 and 1823. It is kept in Bold Sharav's private library.

- Dri med shel gyi me long. Handwritten short text in Tibetan. Date unknown. It is kept in Bold Sharav's private library.

- Medical short text with manuscript in Tibetan. Date unknown. It is kept in Bold Sharav's private library.

2. Research method

We used the hermeneutic research method and the checklist method in our research. The checklist method was applied to categorise and list the facts and information about arsenic in the selected sources. Furthermore, the specific elements identified within these compiled facts and details concerning arsenic and arsenic-containing mineral medicines were subsequently examined in depth.

RESULTS

Several studies have been conducted on the modern medical uses of arsenic. Namely, to date, the traditional Chinese medical practitioners still prescribe arsenic in medicines for asthma, rheumatoid diseases, syphilis, and psoriasis[13], although there is a lack of scientific evidence to clarify arsenic's therapeutic effects in the diseases mentioned earlier. In the 1970s, a scientist at Harbin Medical University (China) made a breakthrough discovery on the treatment of APL by As_2O_3[14]. Collectively, the emergence of the As_2O_3 drug has made a great turning point in APL history. APL is no longer a dreadful malignancy but highly curable[15,16].

However, the medical use of arsenic in Mongolia has been insufficiently studied. Therefore, this research was conducted to clarify how arsenic was utilised in traditional Mongolian medicine and to identify the diseases it was used to treat, as described in ancient medical books and manuscripts written in Tibetan by doctors and scholars of traditional Mongolian medicine. The findings of this study are presented in four sections as follows.

Nomenclature, attenuation, and uses of arsenic

Arsenic in Tibetan: *rdo dug*

In Mongolian: *Khüntsel*

In Latin: *Arsenicum*

According to traditional medical theory, arsenic is considered to have a hot taste and to be toxic. It can inhibit necrosis, treat bacterial infections, and promote expectoration. It is commonly used to treat bacterial diseases, including malignant glandular growths, syphilis, malignant anthrax, hemorrhoids, and aphthous fever. Externally, it is applied in powdered form, while internally it may be administered as an adjunct to oral formulations such as powder and pills, with a single dose not exceeding 0.01-0.03 grams. This dosage should not be exceeded. However, it is prohibited to use it in decoction[17].

To attenuate, the cleaned stone poison is wrapped in fresh beef and heated over a fire. Once the meat is cooked, it is removed, cooled, and the coals on the surface of the meat are cleaned off before use. Excessive ingestion may lead to poisoning, and administration is prohibited during pregnancy. During our research, additional arsenic-containing minerals were also identified from sources such as 'Khrungs dpe dri med shel gyi me long, and Sman' khrungs dpe dri med shel gyi me long, and Toin Jambaldorj's "Gso byed bdud rtsi' khrul med ngos' dzin bzo rig me long du rnam par shar pa mdzes mtshar mig rgyan zhes bya ba bzhugs so" [18,19].

Realgar

In Tibetan, it is called dan rog, and in Latin, realgar. Realgar is a mineral of the arsenic sulphide compound (As_4S_2). In addition to the toxic arsenic oxide, AS_2O_3, it contains trace amounts of heavy metal salts. In "Gso byed bdud rtsi' khrul med ngos' dzin bzo rig me long du rnam par shar pa mdzes mtshar mig rgyan zhes bya ba bzhugs so" by Toin Jambaldorj: Realgar is orange in colour and has an unpleasant odour. Upon combustion, it emits yellowish smoke. When dissolved in water, it produces a clear red solution. This is considered the highest quality realgar. Conversely, an orange-brown solution is regarded as poor quality[20]. The attenuation of realgar involves mixing it with water and thoroughly mashing it, followed by the addition of 100 ml of water and 5 g of salt. After dissolving the salt, the mixture is stirred and allowed to settle; the supernatant liquid is then transferred to a clean container, while the sediment is repeatedly mashed. This process is repeated several times, after which the remaining mixture is discarded. The previously collected liquid is allowed to settle, the clear supernatant is decanted, and the resulting powder is dried, ground into a fine powder, and used for medicinal purposes. Traditionally, realgar has been used to prevent fungal infections, treat glandular growths, hair loss, scabies, and snake venom, as well as to manage infectious diseases such as tuberculosis, diphtheria, and aphthous fever. It also heals wounds, dries lymph, and treats syphilis, malignant anthrax, malignant glandular growths, and cures bacterial infection in addition to drying exudates and controlling scabies. Arsenic toxicity is mitigated using Euphorbia Mongolica[21]. In the renowned scripture "Dag yig mkhas pa'i' byung gnas," it was first recorded in Mongolian as "Altan khükher" (realgar)[22]. According to the "Encyclopedia of Mongolian Studies", realgar is characterised as bitter with a hot taste and having warm and heavy properties. It is also highly poisonous. It has the effect of healing wounds, inhibiting necrosis, drying lymph, reducing swelling, and treating bacterial infection. For wound treatment, it is used in combination with single medicines such as stone vermillion, white vermillion and red lead to promote healing and control inflammation, for the composition of Shunkh-7. For bacterial diseases such as diphtheria and anthrax, it was used as an ingredient in Gaa-3 prescription, combined with a bactericidal drug such as turmeric root[23], for malignant glandular growths, used in combination with medicinal agents such as blister beetle, as part of the multi-component formulation known as Stone poison-6 prescription.

Orpiment

In Tibetan, it is referred to as Bala, and in Latin, as Auripigmentum or Orpiment. This mineral is an arsenic sulphide compound (As_2S_3), composed of approximately 61% arsenic and 39% sulphur. It typically exhibits a lemon-yellow colouration, although some specimens may appear light green, and possesses a slightly pungent odour.

According to "Gso byed bdud rtsi 'khrul med ngos' dzin bzo rig me long du rnam par shar pa mdzes mtshar mig rgyan zhes bya ba bzhugs so" by Toin Jambaldorj, yellow mineral resembles gold ore in colour and has a mild odour. When combusted, it produces yellow smoke. High-quality ones are characterised by a clear yellow colouration and a shape resembling a horse's tooth, whereas orange or greenish ones are considered of inferior quality[24].

Depending on the intended use, orpiment is attenuated using two different methods. For external applications, it is ground into a fine powder, similar to the preparation of realgar. For internal use, purified

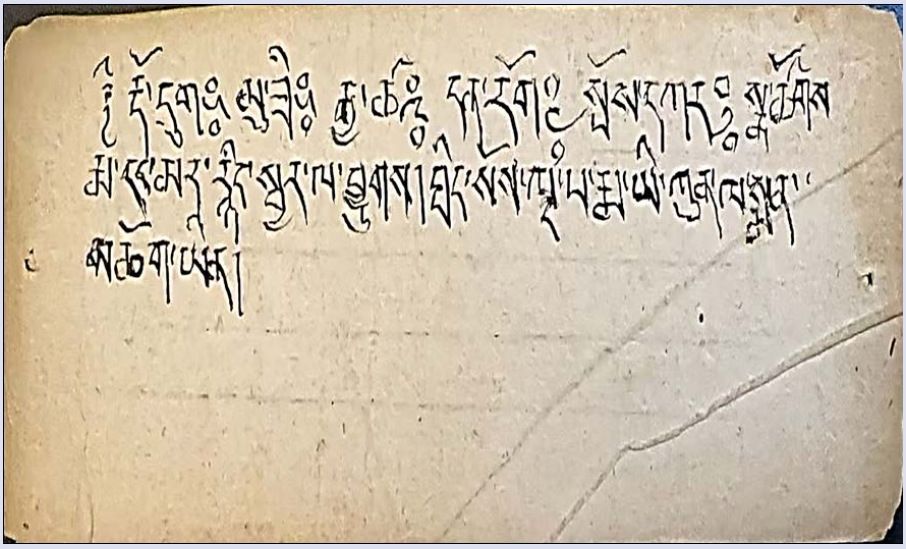

Figure 1. Manuscript with stone poison composition

orpiment is wrapped in fresh beef, crushed, and the outer meat, after cooking, is employed as the medicinal component.

According to the "Encyclopedia of Medicinal Plants of China", stone yellow mineral, or orpiment, is bitter, possesses a balanced quality, and is toxic. It has traditionally been attributed with therapeutic effects such as treating inflammation, suppressing glandular tumours, drying lymph, and exhibiting antibacterial activity. Due to its properties, orpiment is combined with bezoar, arsenic, wolf's bane (aconite), deer's musk, balsam, and Juniperus communis to form the medicinal formulation Arsenic-7. It is mixed with golden gentian, bear bile, and deer's musk for the formulation of Altan degd-4 medicine, due to its properties of reducing inflammation, drying up lymph, and healing scabs [25].

In "Dri med shel gyi me long," the orpiment is described as having a hot taste and is attributed with properties such as promoting wound healing, treating swollen glands and skin diseases, drying lymph, neutralising snake venom, and demonstrating antibacterial and anti-syphilitic activity[26].

The use of stone poison in a newly discovered ancient medicinal manuscript

During our research, we identified a small ancient medical manuscript that lists several medicinal substances containing stone poison or arsenic (Figure 1).

In Tibetan:

རྡོ་དུག་མུ་ཟི། རྒྱ་ཚ། དན་རོག ལྤགས་དཀར།

སྣ་ཚོགས་རྩ་དང་མར་རྙིང་སྦྱར་ལ་བྱུགས།

ཐིང་སོལ་ལྔ་པ་རྩ་ཡི་ཀུན་ལ་སྨན་མཆོག་ཡིན།

Wylie transliteration:

rdo dug mu zi rgya tsha dan rog spos dkar

sna tshogs rma dang mar rnying sbyar la byugs

thing sos lnga pa rma yi kun la sman mchog yin

English translation:

Ingredients: Arsenic, sulphur, sal ammoniac, realgar, resin of the plant Shorea robusta. It is mixed with aged oil and applied to various wounds.

Edgeegch-5 (Expanded healer-5) powder for all ulcers and wounds.

Explanation of the terms:

རྡོ་དུག *rdo dug* - stone poison ot arsenic

མུ་ཟི mu zi - Sulphur native

རྒྱ་ཚ rgya tsha - Sal ammoniac

དན་རོག dan rog - Realgar

ལྤགས་དཀར spos dkar - Resin of the plant Shorea robusta

ཐིང-hall, room, spread, distribute, སོས-to treat, to heal, ཐིང་སོས་ལྔ (thing sos lnga) - Delgerüülen Edgeegch-5 (Expanded healer-5). This refers to the name of a medicinal preparation primarily used by mixing it with aged oil and applying it to various forms of scabies. It is regarded as one of the most effective treatments for all types of scabies.

DISCUSSION

In the handwritten short text and ancient medical books, arsenic is called *rdo dug* in Tibetan, stone poison or khüntsel in Mongolian, and Arsenicum in Latin. It is referred to as the "poison of kings" due to its potent toxicity, as ingestion in large quantities can result in rapid death. Nevertheless, ancient medical books describe that if arsenic is properly attenuated and used in medicine, its benefits are truly immense[27]. According to traditional Mongolian medicine theory, arsenic is hot in taste and poisonous, with the effect of drying pus, inhibiting necrosis, and curing bacterial infections. It is usually used to treat bacterial diseases, syphilis, malignant anthrax, hemorrhoids, and aphthous fever disease. Externally, arsenic is applied in the form of an ointment and is added to the prescription of medicines such as powder and pills, and the amount of one dose is 0.01-0.03 grams, and this amount should not be exceeded. It is prohibited to be added to decoction medicine, and should not be administered to pregnant women[28,29]. Several sources describe the use of arsenic alone. Information regarding its use in combination with other medicines, however, is limited. During the course of this research, it was newly identified that an ancient manuscript referenced arsenic as an active ingredient. This manuscript, a single-page scripture, is poorly written but contains exceptionally rare information. It describes a medicine called Thing

sos lnga, or in Mongolian, Delgerüülen Edgeegch-5 powder (Expanded healer-5), which is primarily composed of arsenic. Arsenic serves as the active ingredient, while the other constituents are sulphur native, sal ammoniac, realgar, and resin of the plant Shorea robusta. The preparation is combined with aged oil and applied to various wounds, and it is considered one of the most effective remedies for all ulcers and wounds[30]. It is important to further study the traditional medicinal uses of this mineral in comparison with modern medical uses.

CONCLUSION

The research results revealed that there are several clear references to arsenic in ancient traditional Mongolian medical books and manuscripts written in Tibetan and Mongolian. The Tibetan name for arsenic is *rdo dug*, the Mongolian name is khüntsel, and the Latin name is Arsenicum. The findings indicate that arsenic is incorporated into several traditional prescriptions and serves as an active component in certain medicinal formulations.

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