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IN VITRO ANTICOAGULANT EFFECTS OF DIFFERENT TYPES OF MUMIE ASSESSED BY THE LEE–WHITE METHOD

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Abstract: Mumie is a natural mineral–organic substance widely used in traditional medicine for various therapeutic purposes. However, its effects on blood coagulation may vary depending on geographical origin and chemical composition. To compare the *in vitro* effects of different types of mumie on whole-blood coagulation using the Lee–White method. Whole-blood coagulation time was assessed *in vitro* according to the Lee–White method. Samples of Afghan, Indian, Chinese, and Transbaikal mumie were tested at concentrations ranging from 1 to 10 mg/mL. Control samples were analyzed without mumie. Coagulation time was recorded in minutes and compared across different mumie types and concentrations. Afghan, Indian, and Transbaikal mumie demonstrated pronounced anticoagulant activity, characterized by a dose-dependent prolongation of blood coagulation time. At concentrations of 2–5 mg/mL, coagulation time increased up to 30 minutes, while Afghan mumie at 10 mg/mL prolonged coagulation time to 90 minutes. In contrast, Chinese mumie exhibited minimal effects on coagulation, with only slight increases in clotting time across tested concentrations.

Keywords: Mumie, blood coagulation, anticoagulant activity, Lee–White method, traditional medicine, *in vitro* study.

Introduction

According to the World Health Organization (WHO), traditional medicine (TM) comprises a wide range of healthcare practices based on plant-, mineral-, and animal-derived substances, which may be used individually or in combination to treat diseases, prevent illness, and maintain overall health and well-being (1). TM is organized into several established medical systems, including Traditional Persian Medicine (TPM), Traditional Arabic Medicine, Traditional Chinese Medicine (TCM), and Traditional Indian Medicine (Ayurveda) (2).

Within these traditional medical frameworks, Mumijo is categorized as a herbomineral exudate with a long-standing ethnopharmacological history. For centuries, it has been highly valued in diverse cultures inhabiting mountainous regions. Although most commonly associated with the Himalayan ranges of India (3,5), Mumijo is widely distributed across several regions of the former Soviet Union, including the Ural, Altai, Caucasus, Sayan, and Baikal mountain systems, as well as parts of Kazakhstan, Uzbekistan, and Tajikistan. Beyond Central Asia, Mumijo deposits have also been identified in China, Pakistan, Nepal, Afghanistan, and Tibet (6). Historically, this substance has been recognized under numerous names across different cultures, such as Shilajit or Silajita in Indian medicine, Asphalt in English, Silajatu in Bengali, Rock Juice in Tibetan medicine, Mountain Conqueror in Sanskrit, Hajarul-Musa or Arak al-Jebal in Arabic, Mumiyo or Mumnae in Persian, μουμία in Greek, Muemu in Russian, and Mumiyo in German. Additional descriptors include mineral resinous bitumen, Jewish bitumen, mineral wax, and Bragshun. Typically ranging in color from light to dark brown, Mumijo has been used for over 3,000 years as a rejuvenating agent and a powerful adaptogen (4).

The origin of Mumijo remains a topic of ongoing scientific discussion, with three primary explanatory models proposed: biological, geological, and bio-mineralogical. The biological hypothesis suggests that Mumijo arises from the gradual decomposition of plant matter or the metabolic byproducts of animals under specific environmental and physicochemical conditions.

The geological hypothesis attributes its formation to prolonged geological processes, whereas the bio-mineralogical theory integrates both perspectives, proposing that Mumijo is a complex substance formed through interactions between organic precursors and surrounding mineral matrices. A variety of environmental factors—including regional flora, geological substrate, soil composition, mineral content, climatic conditions (temperature and humidity), altitude, and local ecological characteristics—play critical roles in determining both the chemical composition and therapeutic properties of Mumijo (9). Despite sharing similar physical characteristics across geographical regions, its chemical profile varies considerably. In general, Mumijo contains approximately 60–80% organic matter, 20–40% inorganic components, and trace elements such as iron, calcium, copper, zinc, magnesium, manganese, molybdenum, and phosphorus (10).

Classical medical texts provide extensive documentation of the medicinal uses of Mumijo. In the 10th century, the physician Ahvazi described its therapeutic benefits in *Kamāl as-Sanā'a*, recommending its use for cold-type headaches, hemoptysis, asthma, and facilitation of the expulsion of retained fetuses. Avicenna, in *The Canon of Medicine*, characterized Mumijo as a potent neurotonic capable of strengthening cerebral function, enhancing fertility, and treating a wide range of diseases. Later, in the 12th century, Jurjani's *Zakhire Khwārizmshāhi* further emphasized its effectiveness in managing inflammatory conditions, ulcers, urinary disorders, and prostate-related ailments (7).

Across various traditional healing systems, Mumijo has been administered in different dosage forms to address a broad spectrum of pathological conditions. These include disorders of the urinary tract, jaundice, gallstones, gastrointestinal disturbances, splenomegaly, epilepsy, hypersensitivity reactions, neurological diseases, chronic bronchitis, tuberculosis, dermatological conditions such as eczema, anemia, and diabetes mellitus (11). However, the presence of fungal contamination and associated mycotoxins remains a significant challenge, limiting its standardization and broader clinical application (12).

Traditional practitioners continue to attribute a wide range of pharmacological effects to Mumijo, including aphrodisiac activity, nephrolithiasis prevention, relief of musculoskeletal pain, acceleration of fracture healing, and therapeutic benefits in osteoarthritis and spondylitis. Additional traditional uses include the management of edema, hemorrhoids, age-related degeneration, wound disinfection, metabolic disorders, and weight regulation (9). Contemporary pharmacological investigations have provided partial scientific validation for these claims, identifying anti-inflammatory, antioxidant, antimutagenic, and immunomodulatory activities largely associated with its fulvic acid (FA) and humic acid (HA) content. These bioactive constituents have stimulated growing interest in Mumijo as a potential chemopreventive agent (10). Experimental studies further demonstrate that Mumijo can reduce blood glucose levels, improve lipid metabolism in animal models (13), stimulate nucleic acid synthesis, and enhance mineral transport to bone and muscle tissues (6). Moreover, Mumijo has been shown to promote diuresis and natriuresis, supporting its traditional application in the treatment of urinary and renal disorders (14).

Materials and Methods

Different geographical types of mumie were used in this study, including Chinese, Afghan, Indian, and Transbaikal mumie. All samples were purified according to standard procedures and dissolved in physiological saline to prepare solutions at concentrations of 1, 2, and 5 mg/mL immediately before use. Fresh whole blood was obtained from healthy donors who had not taken any anticoagulant or antiplatelet medications for at least two weeks prior to sampling. All procedures were conducted in accordance with accepted laboratory and ethical standards. Blood coagulation time was determined *in vitro* using the Lee–White method, a classical assay for evaluating whole-blood coagulation. Briefly, aliquots of freshly collected blood were placed into clean, dry glass test tubes and incubated at 37 °C. Test solutions of different types of mumie were added to the blood samples at the specified concentrations, while control samples received no test substance. The coagulation time was recorded as the interval from blood collection to the complete formation of a stable clot. Each experiment was performed in replicate, and mean values were calculated. The effects of different types and concentrations of mumie on blood coagulation time were compared with control samples. Results were expressed as relative changes in coagulation time. Dose–response relationships were evaluated to determine the dependence of anticoagulant activity on mumie concentration.

Results

The effects of different geographical types of mumie on whole-blood coagulation time, as determined by the Lee–White *in vitro* method, are presented in Table 1. In control experiments, blood coagulation occurred within 3–6 minutes, depending on the sample.

Table 1.Effect of Different Types of Mumie on Blood Coagulation Time (*In Vitro*, Lee–White Method)

Type of Mumie	Control	1 mg/mL	2 mg/mL	5 mg/mL	10 mg/mL
Afghan	6	16	30	30	90
Indian	3	5	16	30	–
Chinese	3	4	6	8	–
Transbaikal	3	11	28	30	–

Statistically significant differences ($p < 0.05$) compared with baseline values.

Afghan mumie demonstrated a pronounced anticoagulant effect. At a concentration of 1 mg/mL, coagulation time increased from 6 minutes in the control to 16 minutes. Further increases were observed at 2 and 5 mg/mL, where coagulation time reached 30 minutes. At the highest tested concentration (10 mg/mL), coagulation time was markedly prolonged to 90 minutes, indicating strong dose-dependent anticoagulant activity.

Indian mumie also exhibited anticoagulant properties, though to a slightly lesser extent. Coagulation time increased from 3 minutes in the control to 5 minutes at 1 mg/mL, 16 minutes at 2 mg/mL, and 30 minutes at 5 mg/mL.

In contrast, Chinese mumie showed minimal influence on blood coagulation. Coagulation time increased only modestly from 3 minutes in the control to 4, 6, and 8 minutes at concentrations of 1, 2, and 5 mg/mL, respectively, indicating weak or absent anticoagulant activity.

Transbaikal (Zabaykalsky) mumie demonstrated significant anticoagulant effects comparable to Afghan and Indian samples. Coagulation time increased from 3 minutes in the control to 11 minutes at 1 mg/mL, 28 minutes at 2 mg/mL, and 30 minutes at 5 mg/mL.

Overall, the anticoagulant activity of mumie varied markedly depending on its geographical origin and increased with rising concentration.

Discussion

The present study demonstrates that different types of mumie exert distinct effects on blood coagulation *in vitro*, as assessed by the Lee–White method. Afghan, Indian, and Transbaikal mumie showed clear anticoagulant properties, whereas Chinese mumie exhibited minimal effect on coagulation time.

The observed differences among mumie samples are likely attributable to variations in chemical composition resulting from distinct environmental and geological conditions. Mumie is known to contain a complex mixture of organic and inorganic components, including fulvic and humic acids, trace elements, and other bioactive substances. Variability in the concentration and ratio of these components may explain the pronounced anticoagulant activity observed in Afghan, Indian, and Transbaikal samples and the relative inactivity of Chinese mumie.

The dose-dependent prolongation of coagulation time observed in this study suggests that mumie interferes with one or more stages of the coagulation cascade. The strong effect observed at higher concentrations, particularly with Afghan mumie, indicates potential inhibition of clotting factor activity or modulation of platelet–coagulation interactions. These findings are consistent with previous reports describing the influence of mumie on hemostatic balance and vascular function.

The minimal anticoagulant effect of Chinese mumie highlights the importance of geographical origin and quality control in both experimental and therapeutic applications. This finding underscores the need for standardization and chemical characterization of mumie preparations prior to clinical or pharmacological use.

Conclusion

This *in vitro* study demonstrates that mumie exhibits anticoagulant activity that is highly dependent on its geographical origin and concentration. Afghan, Indian, and Transbaikal mumie significantly prolonged blood coagulation time in a dose-dependent manner, whereas Chinese mumie showed little to no anticoagulant effect.

These results suggest that certain types of mumie may represent promising natural sources of anticoagulant compounds. However, further studies are required to elucidate the underlying mechanisms of action, identify the active constituents, and assess the safety and efficacy of these substances *in vivo*.

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