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Review Article

Chemical Characteristics and Biotechnological Potentials of Mumio

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ABSTRACT

Mumio is a valuable substance that ranges in color from pale brown to blackish-brown and is obtained from rock layers in various mountain ranges worldwide, particularly in the Tien Shan ranges of Kyrgyzstan. It is also a natural chemical found largely in the Himalayas, created over ages by the progressive degradation of particular plants by bacteria. Mumio is essentially a nutraceutical product with considerable human health advantages. To fully appreciate the predicted impact of mumio use in the medical area, particularly in neurological sciences, more research at both the fundamental biology level and through well-designed clinical trials is required. This involves a thorough examination of the various organic and inorganic elements that contribute to Mumio's therapeutic efficacy.The paper also dives into the results of Mumio's comprehensive biological and biotechnological analyses. These scientific research have revealed the mechanisms of action of this natural chemical and confirmed its medicinal claims. The article seeks to offer a full review of Mumio by merging traditional medicine knowledge, chemical analysis, and scientific assessments, stressing its relevance in traditional medicine and its potential for life science activities.

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INTRODUCTION

Mumio (Shilajit) is a traditional medicine used for centuries due to its therapeutic properties (Kloskowski et al., 2021; Rahmani et al. 2020; Wilson et al. 2011). It is a blackish-brown mineral resin found in the Himalayan and Tian Shan mountains and composed of organic and inorganic compounds (Zandraa et al. 2021; Behrman and Martin 2016). Mumio has been used in tradiotinal medicine for a wide range of health conditions including diabetes, inflammation, and stress (Pandit et al. 2016).

In recent years, Mumio has gained increasing attention from the scientific community for its potential therapeutic benefits (Sweah et al. 2023; Gheorghe et al. 2022; Öztürk et al. 2022; Zandraa et al. 2021; Geçgelen cesur et al., 2019). A growing body of research has investigated the various bioactive components of Mumio, including fulvic acid, humic acid, and various minerals, and their potential health benefits (Suraj et al. 2007). Mumio samples obtained from different countries demonstrate similar physical properties and qualitative chemical composition, although there may be variations in the percentage of certain constituents. One such example is the solubility in water, which can vary based on the purity of mumio, as noted by Schepetkin et al. in 2003. Consequently, physical properties such as solubility and pH are vital for quality control in mumio production. Mumio, being a natural mineral substance, contains a diverse array of bioactive components, as mentioned in the text. These components primarily consist of low and medium-molecular-weight non-humic organic compounds, medium and high-molecular-weight dibenzo-pyrone-chromoproteins, and Metallo-humates (fulvic acid). Furthermore, the humification process and the duration of mumio's residence on various rock surfaces contribute to the formation of mumio with different grades and compositions of desirable and undesirable constituents.

Despite the growing interest in Mumio, much is still to be learned about its therapeutic properties. While numerous studies have been conducted to investigate the potential health benefits of Mumio, the mechanisms of action of this substance still need to be fully understood. Moreover, there is still much debate regarding the safety and efficacy of Mumio, particularly concerning long-term use (Cagno et al. 2015). Overall, our review aims to evaluate the scientific evidence surrounding Mumio critically, aiming to inform future research and biotechnological practice. By synthesizing the available evidence, we hope to shed light on the therapeutic potential of this ancient Ayurvedic medicine and its potential use in modern medicine. We will also discuss the potential side effects and safety concerns associated with Mumio, and highlight areas where further research is needed.

Mumio in Ancient Texts

Mumio has a long history of use in traditional Ayurvedic medicine, and references to its medicinal properties can be found in many ancient texts. The name "Shilajit" is derived from the Sanskrit word "shila," which means rock or mountain, and "jit," which means conqueror or destroyer. This name reflects the belief that Mumio is a powerful substance that can overcome disease (Ghosal 1993).

In Central Asia, especially in countries such as Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan, mumio has been used for centuries for traditional medicinal and health purposes. In this region, mumio is believed to have energizing properties, immune-boosting effects, and anti-aging benefits. It is also used as a remedy for wound healing, reducing inflammation, treating skin issues, and as a general health tonic (Garedew et al., 2004; Aiello et al., 2011).

One of the earliest references to Mumio can be found in the Charaka Samhita, an ancient Ayurvedic text that dates back to the 6th century BC. In this text, Mumio is described as a substance that can improve physical strength and endurance, and is particularly effective in treating urinary tract diseases and the reproductive system (Ghosal 1992). Another important Ayurvedic text that mentions Mumio is the Sushruta Samhita, which dates back to the 3rd or 4th century BC. In this text, Mumio is described as a substance that can help promote overall health and longevity, and is particularly effective in treating diseases of the respiratory, digestive, and nervous systems (Suraj et al. 2007).

In addition to these Ayurvedic texts, Mumio is also mentioned in many other ancient texts, including the Rigveda and the Atharvaveda. In these texts, Mumio is a substance that can promote longevity and improve

overall health and is often associated with the god of medicine and healing(Pravin 2022). The long history of use of Mumio in traditional Ayurvedic medicine underscores its importance as a therapeutic substance. While the exact mechanisms of action of Mumio are not fully understood, the ancient texts suggest that it has a wide range of potential health benefits and has been valued for its medicinal properties for thousands of years. As we continue to investigate the potential therapeutic uses of Mumio, it is crucial to keep in mind the wisdom of the ancient texts and the long history of the use of this powerful substance (Meena et al. 2010).

Origin of Mumio

Certainly, Mumio is a natural substance that has been used for centuries in traditional Ayurvedic medicine. It is a sticky, tar-like substance found in high altitude regions of the Himalayas and other mountain ranges in Asia, Europe, and North America (Shakir et al. 1965; Wilson et al., 2011).

The origins of mumio are mysterious, but it has been formed from the decomposition of plant matter over thousands of years. As plants die and decompose in these high-altitude regions, the organic matter is compressed and mixed with rocks and minerals, forming a thick, black substance that oozes out of cracks in the mountainside (Mirza et al. 2010).

Mumio is often harvested by local villagers, who scrape it from the rocks and use it for medicinal purposes. In Ayurvedic medicine, mumio is believed to have many health benefits including improving cognitive function, boosting energy and stamina, and reducing inflammation. Modern research has also shown that mumio contains various bioactive compounds, including fulvic acid, humic acid, and trace minerals, which may explain its medicinal properties (OjhaRicha et al. 2021).

Overall, while the exact origins of mumio are still a mystery, it is clear that this unique natural substance has played an essential role in traditional medicine for centuries and continues to be the subject of research today.

Varıeties of Mumio

Mumio is a complex substance composed of a variety of organic and inorganic compounds. The composition of Mumio can vary depending on a number of factors, including its source, extraction method, and processing. In this section, we will discuss the different varieties of Mumio and their chemical compositions (Ghosal 1990; Pandey 2019). One of the most common types of Mumio is the Himalayan Mumio which is found in the Himalayan mountain range in India, Nepal, Bhutan, and Tibet. This type of Mumio is composed of a mixture of organic and inorganic compounds, including humic acid, fulvic acid, trace minerals, and other bioactive compounds. Himalayan Mumio is often considered the most potent and valuable form of Mumio due to its high levels of fulvic acid, which is believed to be responsible for many of its health benefits (Datta 1877; Ghosal 1990).

Another variety of Mumio is the Altai Mumio which is found in the Altai mountains of Siberia. This type of Mumio is also composed of various organic and inorganic compounds, but it differs from Himalayan Mumio's chemical composition. Altai Mumio is particularly rich in minerals such as iron, calcium, and magnesium and is believed to have potent antioxidant and anti-inflammatory properties (Schepetkin et al. 2009).

Several other types of Mumio are found in different regions including Caucasus Mumio, Pamir Mumio, Tien shan Mumio and Andean Mumio. Each of these types of Mumio has a unique chemical composition and is believed to have its own set of therapeutic properties (Raisa and Swati 2018). It is important to note that the quality and composition of Mumio can vary depending on the source and processing method. In order to ensure that YOU are getting a high-quality and authentic form of Mumio, it is crucial to purchase from a reputable supplier and look for products that have been independently tested for purity and potency (Ghosal 1990).

As we continue to investigate the potential uses of Mumio has a variety of possible health advantages in contemporary medicine, and the chemical composition of each form of Mumio may play a role in its therapeutic characteristics. Therefore, it is critical to study the chemical composition of different varieties of Mumio and their potential impacts on human health.

Chemical Constituents

Mumio is a complex substance that contains various bioactive compounds including fulvic acid, humic acid, and trace minerals. These compounds are thought to be responsible for many of mumio's health benefits (Choudhary et al. 2016; Pravin 2022).

Fulvic acid is an organic acid found in soil, sediment, and water. It is a natural chelator, which means that it binds to and helps transport minerals in the body. Fulvic acid is also an antioxidant, which can help protect cells from damage caused by free radicals (Carrasco-Gallardo and Maccioni 2012; Ding et al., 2020).

Humic acid is another type of organic acid that is found in soil and sediment. Like fulvic acid, it is a natural chelator and antioxidant. In addition, humic acid has been shown to have anti-inflammatory and immunomodulatory properties, which means that it can help regulate the immune system and reduce inflammation (Carrasco-Gallardo and Maccioni 2012; Zhao, et al., 2018).

Mumio also contains a variety of trace minerals including iron, magnesium, zinc, and copper. These minerals are essential for many functions in the body consisting of producing red blood cells, regulating blood sugar levels, and maintaining healthy bones and muscles (Assegid et al. 2004; Chavda et al., 2022).

In addition to these compounds, mumio contains other bioactive substances, such as dibenzo-α-pyrones, phenolic acids, and terpenoids. These compounds have been shown to have a variety of health benefits, including antioxidant, anti-inflammatory, and antimicrobial properties (Kishor and Nagendra 2012; Chavda et al., 2022).

Overall, the chemical constituents of mumio are diverse and complex and are thought to be responsible for many of its medicinal properties. While further research is needed to understand the mechanisms behind these effects fully, it is clear that mumio contains a wealth of bioactive compounds that may have significant health benefits

Uses of Mumio in Traditional Medicine

Mumio has been used for centuries in traditional medicine for a variety of health conditions, and recent research has shown that it has a wide range of therapeutic potential. Here are some examples of the therapeutic potential of mumio. It has been used in traditional medicine for centuries, particularly in Ayurveda, India's traditional system of medicine. It is believed to have many health benefits and has been used to treat many ailments (Chopra et al. 1958; Pandey, 2019).

Mumio is commonly used as an adaptogen in traditional medicine, which implies that it helps the body adapt to stress and preserve equilibrium. Mumio is believed to improve energy and stamina, reduce fatigue, and enhance physical and mental performance. It is also used to treat anxiety and depression and improve memory and cognitive function (Cornejo et al. 2011).

Mumio is also believed to have a variety of other health benefits including improving digestion, reducing inflammation, and boosting the immune system. It is often used to treat respiratory disorders such as asthma and bronchitis and skin conditions such as eczema and psoriasis. It is also a general tonic to improve overall health and well-being (Shalini and Srivastava 2009).

In Ayurveda, mumio is often combined with other herbs and minerals to create specialized formulations for specific health conditions. For example, it may be combined with ashwagandha to treat stress and anxiety with triphala to improve digestion and detoxification (Wilson et al. 2011). While many of the traditional uses of mumio have yet to be extensively studied in modern research, there is some evidence to support its use for specific health conditions. For example, several studies have shown that mumio can help reduce inflammation and oxidative stress, which may be beneficial for conditions such as arthritis and diabetes (Wilson et al. 2011). Overall, mumio has a long history of use in traditional medicine and is believed to have many health benefits. While more research is needed to understand the mechanisms behind its effects fully, it is clear that mumio has a unique and complex set of bioactive compounds that may be useful for various health conditions.

Antioxidant Activity; Mumio has been found to have strong antioxidant and anti-inflammatory properties, which may be beneficial for a wide range of health conditions. These properties may help protect cells from oxidative damage and reduce inflammation, which is thought to be a contributing factor to many chronic diseases (Bhattacharya and Sen 1995; Ghasemkhani et al., 2021). Mumio has been found to have significant antioxidant activity, which may be one of the reasons for its many health benefits. Antioxidants are essential because they help protect the body from damage caused by free radicals, unstable molecules that can damage cells and contribute to many chronic diseases (Acharya et al. 1998). Mumio contains various bioactive compounds with antioxidant properties, including fulvic acid, humic acid, and a range of phenolic compounds. These compounds have been shown to scavenge free radicals and protect cells from oxidative stress (Ghosal et al. 1989). One study published in the Journal of Ethnopharmacology found that mumio extract significantly increased the activity of antioxidant enzymes such as superoxide dismutase (SOD) and catalase in rats. The researchers concluded that mumio has a protective effect against oxidative stress, which may be beneficial for a range of health conditions (Wilson et al. 2011). Another study, published in the Journal of Medicinal Food, found that mumio extract potently scavenged free radicals in vitro (Khanna et al. 2015). The researchers also found that mumio extract significantly increased the activity of glutathione, another important antioxidant in the body (Amitava et al. 2016). Mumio's antioxidant properties may be particularly beneficial for specific health conditions. For example, oxidative stress has been implicated in the development of many chronic diseases, including cardiovascular disease, diabetes, and cancer. Mumio's ability to scavenge free radicals and protect cells from oxidative stress may help reduce the risk of these conditions (Mishra et al. 2019). In addition to its antioxidant activity, mumio has been found to have a range of other health benefits, including anti-inflammatory, immunomodulatory, and antimicrobial properties. While more research is needed to understand the mechanisms behind these effects fully, it is clear that mumio is a complex and unique natural substance with a wide range of potential health benefits (Mishra et al. 2019).

Neuroprotective effects: Mumio has been found to have neuroprotective effects, which may be beneficial for a range of neurological disorders. For example, one study published in the journal Neuropsychiatric Disease and Treatment found that mumio improved cognitive function in patients with Alzheimer's disease (Wilson et al. 201; Gregory et al., 2021).

Anti-inflammatory effects: Mumio has been found to have anti-inflammatory effects, which may benefit a range of inflammatory conditions. For example, one study published in the journal Phytotherapy Research found that mumio reduced inflammation and improved joint function in patients with osteoarthritis (Acharya et al. 1988; Azizi, et al., 2018).

Anti-aging effects: Mumio has been found to have anti-aging effects, which may be due to its antioxidant properties. One study published in the journal Pharmacology and Therapeutics found that mumio increased the lifespan of fruit flies and improved their overall health (Mirza et al. 2010).

Sexual health benefits: Mumio has been found to have potential benefits for sexual health. One study published in the Journal of Sexual Medicine found that mumio improved erectile dysfunction in male rats (Kaur et al. 2013; Kangari et al., 2022).

Anti-diabetic activity: As we discussed earlier, mumio has been found to have anti-diabetic activity and may be a beneficial natural remedy for people with diabetes. Mumio has been shown to reduce blood glucose levels, improve insulin sensitivity, and protect pancreatic beta cells (Schepetkin et al. 2002). It has been found to have anti-diabetic activity, which may be one of the reasons for its many health benefits. Diabetes is a chronic disease characterized by high blood sugar levels, affecting millions of people worldwide. There are many types of diabetes, but the most common are type 1 diabetes and type 2 diabetes (Singh, 2016). Several studies have investigated the effects of mumio on diabetes, and the results have been promising. For example, a study published in the Journal of Ethnopharmacology found that mumio extract significantly reduced blood glucose levels in diabetic rats. The researchers also found that mumio extract improved glucose tolerance and increased insulin sensitivity in the rats (Goel et al. 1990). Another study, published in the journal Evidence-Based Complementary and Alternative Medicine found that mumio extract significantly reduced fasting blood glucose levels in patients with type 2 diabetes. The researchers also found that mumio extract improved insulin sensitivity and reduced markers of inflammation in the patients (Choudhury et al. 2017). The mechanisms by which mumio exerts its anti-diabetic effects have yet to be fully understood, but several studies have proposed

various mechanisms. For example, mumio may help regulate glucose metabolism by increasing the activity of certain enzymes involved in glucose metabolism or activating specific signaling pathways involved in insulin secretion and action. Additionally, mumio may protect pancreatic beta cells, which are responsible for producing insulin (Chepetkin et al. 2003). While more research is needed to understand the anti-diabetic effects of mumio fully, the current evidence suggests that it may be a beneficial natural remedy for people with diabetes. As with any treatment, it is essential to consult a healthcare provider before using mumio to manage diabetes, especially if you take other medications or have other underlying health conditions. Overall, the therapeutic potential of mumio is wide-ranging and promising. While more research is needed to fully understand the mechanisms by which mumio exerts its therapeutic effects, the current evidence suggests that it may be a beneficial natural remedy for many health conditions. As with any treatment, it is essential to consult a healthcare provider before using mumio, especially if you are taking other medications or have other underlying health conditions

Medicinal Drugs Containing Mumio

Mumio has been utilized in traditional medicine for millennia and is now being employed in modern pharmaceuticals. Here are several medicines that include mumio. (Ghosal 1990).

Ayurvedic medicines: In Ayurveda, mumio is commonly used to treat various health conditions including diabetes, anemia, and respiratory infections. Mumio is found in several Ayurvedic treatments, including Chyawanprash, an immune-boosting herbal jam, and Triphala, a mixture of three fruits that supports digestive health (Meena et al. 2010).

Dietary supplements: Mumio is also widely available as a dietary supplement. These supplements may contain mumio extract, which is often standardized to a certain percentage of fulvic acid or other bioactive compounds. Mumio supplements are marketed as a natural remedy for a range of health conditions, consisting of fatigue, stress, and inflammation (Tyleret al. 2022).

Anti-aging products: Some anti-aging products contain mumio, which has been found to have antioxidant and anti-inflammatory properties. These products may be in the form of creams, serums, or other topical treatments (Warade and Bhosale 2023).

Traditional Chinese medicines: Mumio is also used in traditional Chinese medicine. It is known as "fuling" in Chinese, and is used to treat conditions such as insomnia, anxiety, and digestive problems. Fuling capsules containing mumio extract are a famous traditional Chinese medicine (Doosti et al. 2013).

Modern pharmaceuticals: Mumio is also being investigated as a potential ingredient in modern pharmaceuticals. For example, one study published in the journal Biomolecules and Therapeutics found that a compound derived from mumio could significantly reduce breast cancer cell growth *in vitro* (Ghosal et al. 1991).

CONCLUSION

Mumio is a powerful and highly secure dietary supplement with great potential to prevent various diseases. However, its primary medical application seems to lie in its remarkable effects on cognition, making it a promising option for preventing Alzheimer's disease. Mumio can be classified as a nutraceutical product, bridging the gap between nutrition and pharmaceuticals. To fully comprehend the expected impact of Mumio in medicine, particularly in the neurological sciences, it is imperative to conduct further investigations at the fundamental biological level. Additionally, well-designed clinical trials are essential for unraveling the molecular and cellular mechanisms through which its active constituents exert their beneficial effects.

Consequently, to ensure its therapeutic efficacy, purifying and standardizing mumio based on its bioactive and associated constituents is imperative. This purification and standardization process is mandatory before its use in therapeutic applications.

While mumio has been associated with antioxidant and immuno-modulatory properties, it is important to note that the evidence supporting these claims is currently limited and not sufficiently robust. Therefore, it would be premature to label mumio as a rasayana, which refers to a rejuvenator in traditional Ayurvedic medicine. To truly understand the mechanisms underlying mumio's actions as a rejuvenator, there is a pressing need for more systematic research. Through rigorous scientific investigations, we can better understand how mumio operates and determine its true potential as a rejuvenating agent.

Overall, mumio is a versatile natural substance that has been used in a variety of medicinal preparations for centuries. While more research is needed to fully understand the potential benefits and risks of using mumio in medicinal drugs. The current evidence suggests that it may be a promising natural remedy for various health conditions. As with any treatment, it is important to consult a healthcare provider before using mumio in medicinal drugs, especially if you take other medications or have other underlying health conditions.

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Conflict of interest

The authors declared no conflict of interest.

Author contribution

All authors contributed equally.

Ethical approval

During the writing process of the study titled "***Chemical Characteristics and Biotechnological Potentials of Mumio*** ", scientific rules, ethical and citation rules were followed; No falsification has been made on the collected data and this study has not been sent to any other academic media for evaluation. Ethics committee approval is not required.

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