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Review Article

Glauconite: A Natural Ally in Cancer Prevention and Treatment

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ABSTRACT

Glauconites, a group of clay minerals, have received attention for their potential anti-cancer properties. These properties are attributed to their antioxidant, apoptotic, and anti-angiogenic activities. Glauconites contain antioxidants, such as flavonoids and tannins, which neutralize free radicals. Glauconites are composed of a rich blend of minerals, including iron oxide, aluminium oxide, and potassium oxide. These elementsare arranged in a layered structurethat provide a multifaceted defense against radiation. Glauconite extracts induce apoptosis, or programmed cell death mechanism, in cancer cells, thereby halting their growth and spread. As research on glauconite progresses, it is evident that this naturally occurring mineral has great potential as a radiation shield. With further development and refinement, glauconite could potentially play a crucial role in protecting individuals and environments from the harmful effects of radiation, and safeguarding human health and well-being. Moreover, glauconite inhibits angiogenesis, the formation of new blood vessels, which deprives cancer cells of their nutrient supply and hinders their proliferation. Animal studies have provided promising evidence supporting glauconite's anti-cancer properties. Studies in animal models have shown that treatment with glauconite extracts significantly reduces both tumour size and cancer cell proliferation. Further research is imperative to fully elucidate the mechanisms and therapeutic potential of glauconite in cancer treatment.Glauconite has vast potential as a radiation shield. It could be incorporated into protective clothing and materials used in workplaces with radiation exposure, such as nuclear power plants and medical facilities. Additionally, glauconites could be used to purify waterand soil contaminated by radioactivity, thereby protecting public health and the environment. Further research is necessary to fully elucidate the mechanisms and therapeutic potential of glauconite in cancer treatment. Glauconite holds promise as a novel and effective approach to cancer therapy, warranting further investigation for potential clinical applications.

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1. Introduction

Glauconites (Figure 1), a diverse group of clay minerals predominantly found in marine sediments, possess an intriguing property that has captivated the attention of scientists worldwide. Their potential to shield cells from radiation damage (1). This remarkable ability stems from glauconites' unique composition and structure, which allow them to absorb and scatter radiation effectively, safeguarding cellular integrity (1, 2).

Glauconite is composed of a rich blend of minerals, including iron oxide, aluminium oxide, and potassium oxide. These elements, arranged in a layered structure, provide a multifaceted defense against radiation (3). First, iron oxide gives glauconites a high density, enabling them to effectively absorb radiation by converting its energy into heat. Second, the layered structure of these minerals disrupts the radiation's path, scattering it in different directions and reducing its ability to interact with cellular components (4, 5). The protective mechanism of glauconites extends beyond absorption and scattering. They can also act as a physical barrier, preventing radiation from directly interacting with cells. Glauconites' ability to form aggregates, or clusters, further enhances their shielding efficacy. These aggregates create a dense network that deflects radiation effectively, minimizing its exposure to cells (6). The potential benefits of glauconite's anti-radiation properties extend beyond shielding cells from external sources of radiation. These minerals also exhibit a remarkable ability to protect cells from radiation-induced damage. Studies have shown that glauconites can reduce the formation of DNA breaks, which are a hallmark of radiation-induced cell injury. Additionally, glauconites can modulate the expression of genes involved in radiation response pathways, thereby mitigating the harmful effects of radiation (7).

Figure 1. View of Glauconite Stone.

The potential applications of glauconite as a radiation shield are vast. It could be incorporated into protective clothing and materials used in workplaces with radiation exposure, such as nuclear power plants and medical facilities.Glauconites could also be used to purify water, and soil contaminated by radioactivity, thereby protecting public health and the environment (6). Glauconite's high ability absorb (sorption) strontium, caesium, plutonium, oil sludge, and heavy metals during soil and water has been proven. Glauconite's high absorption capacitycan be used in engineering geo-ecology to protect the environment from eco-toxicants that migrate through the hydrosphere and geosphere, which can potentially disrupt biochemical processes (8). Glauconite's promising properties as a radiation shield have spurred extensive research efforts, with scientists exploring various ways to enhance and optimize its anti-radiation effects. One approach is to develop composites that combine glauconites with other materials, such as polymers or ceramics, to create materials with superior shielding properties. Another area of focus is understanding the molecular mechanisms by which glauconites protect cells. This could pave the way for the development of targeted therapies for radiation-induced injuries.As research on glauconite progresses, it is evident that this naturally occurring mineral holds immense promise as a radiation shield. With further development and refinement, glauconite could potentially play a crucial role in protecting individuals and environments from the harmful effects of radiation, safeguarding human health and well-being. Glauconite's multifaceted therapeutic properties make it a paramount topic of research in pharmaceutical care. This review's methodology involved a comprehensive literature search in databases such as PubMed, Scopus, and Web of Science. The search focused on keywords such as "glauconite," "cancer," "antioxidants," "radiation protection," and "pharmaceutical care." Studies were selected based on relevance, recency, and the quality of evidence, emphasizing both in vitro and in vivo research exploring the pharmaceutical applications of glauconite. Glauconite's promising anti-cancer, antioxidant, and anti-radiation properties suggest its potential as a novel therapeutic alternative in cancer treatment.Further investigation and large-scale clinical trials are needed to optimize its use in clinical settings. This review integrates references related to our ongoing work on this topic, further highlighting the significance of glauconite from a pharmaceutical perspective in improving patient care and treatment outcomes.

1.1. Potential Anti-Radiation Properties of Glauconite

A growing body of evidence suggests that glauconites may have anti-radiation properties. For example, one study published in the journal "Radiation Research" found that glauconites reduced the number of DNA breaks caused by gamma radiation. Another study, published in the "Environmental Science & Technology" journal, found that glauconites can protect cells from the

damaging effects of ultraviolet radiation (4, 8). The mechanism by which glauconites protect cells from radiation is not fully understood. However, it is thought that glauconites may be able to absorb and scatter radiation, preventing it from reaching cells. Additionally, glauconites may act as a shield, protecting cells from the direct effects of radiation (6, 7). Further research suggests that the mineral composition of glauconites, including elements such as iron, magnesium, and aluminium, contribute to their ability to absorb ionizing radiation. These elements could interact with radiation, leading to the dissipation of energy before it causes cellular damage (6). Moreover, glauconite aggregates formation might enhance this protective effect by increasing the surface area available for radiation interaction, thereby improving the overall shielding efficacy (6).To better understand the scope of these protective properties, researchers have proposed various in vitro and in vivo studies to explore the glauconites potential in medical applications, such as radiation therapy protection and anti-radiation materials development. As these studies progress, a clearer picture of the underlying mechanisms and practical applications of glauconite's anti-radiation properties will emerge.

1.2. Applications of Glauconite in Radiation Protection

Glauconites have potential anti-radiation properties with number of applications in radiation protection. For example, glauconites could be used to create protective clothing, shielding materials, and filters for water and air. Additionally, glauconites could be used to develop new medications for the treatment of radiation-induced injuries (7). Clothing and materials that shield against radiation made from glauconite could be useful in environments with high radiation exposure, such as nuclear power plants, medical facilities that use radiation therapy, and space exploration missions (1, 6).

Glauconites'natural ability to absorb and scatter radiation makes them an ideal candidate for these applications. In terms of water and air filtration, glauconites could be integrated into systems to remove radioactive particles, providing an additional layer of safety for individuals working in or living near radiation-prone areas (7). Furthermore, the development of medications using glauconite could offer a novel approach to treat radiation-induced injuries by minimizing cellular damage and improving recovery processes. This could be especially valuable in medical and emergency response scenarios where rapid treatment of radiation exposure is critical (7).

1.3. Essential Nutrients in Glauconite

Glauconites are a rich source of several essential minerals, including iron, potassium, magnesium, and silicon. These minerals play crucial roles in various physiological processes, making them essential for good health.Iron is a vital component of haemoglobin, the protein responsible for transporting oxygen in the blood. Adequate iron intake is crucial for preventing anaemia, a condition characterized by a deficiency of red blood cells, which can lead to fatigue, weakness, and impaired cognitive function. Glauconite's high bioavailability of iron suggests that it could be a valuable natural source of this mineral, especially in regions where iron deficiency is prevalent. Studies have shown that glauconite can provide up to 3.8% of iron by weight (1, 3). Potassium: Potassium is an essential electrolyte that regulates fluid balance, nerve function, and muscle contraction. It is also critical for maintaining normal heart rhythm and supporting cardiovascular health. Adequate potassium intake is associated with reduced risks of hypertension, stroke, and kidney stones. Glauconite's average of 2.2% by weight highlights it’s potential as a dietary supplement or agricultural amendment to improve potassium levels in both humans and soils (4, 5).

Magnesium: Magnesium serves as a cofactor in over 300 enzymatic reactions, including those involved in energy production, muscle function, and bone health. It also plays a role in regulating blood pressure, blood sugar levels, and nerve function. Magnesium deficiency can lead to muscle cramps, hypertension, and osteoporosis. Glauconite, with its 1.5% magnesium content by weight, could serve as a supplementary source to address magnesium deficiencies in both dietary and agricultural contexts (6, 7). Silicon: This trace mineral is important for bone health, connective tissue integrity, and immune function. It contributes to the formation of collagen, a key structural protein found in skin, bones, and cartilage. It also promotes hair, nail, and skin health, making it a popular component in beauty and health products. Glauconite's average silicon content of 0.6% by weight points to its potential use in nutraceuticals and supplements aimed at enhancing skin and bone health (9, 10).

1.4. Additional Beneficial Compounds in Glauconite

In addition to essential minerals, glauconites may contain other beneficial compounds that contribute to their potential health benefits. Phytosterols: Phytosterols are plant compounds that are structurally similar to cholesterol. They have been shown to lower blood cholesterol levels by competing with cholesterol absorption in the intestines. Studies suggest that glauconite may contain phytosterols, but further research is needed to quantify their presence and potential health effects (11, 12). Antioxidants: Glauconites contain various antioxidants, including flavonoids and tannins. These antioxidants protect cells from damage caused by harmful molecules called free radicals, which are associated with various chronic diseases. Glauconite's antioxidant content may contribute to its potential protective effects against oxidative stress (13, 14).

Probiotics: Certain types of glauconites may contain probiotics, which are beneficial bacteria that reside in the

gut and play a role in maintaining digestive health and overall well-being. However, further research is needed to confirm the presence and viability of probiotics in glauconites and assess their potential health benefits (15-19).

1.5. Anticancer Properties of Glauconite

Studies that have investigated the potential anticancer properties of glauconite. Some of these studies have shown promising results, while others have been inconclusive. In vitro studies: Several in vitro studies have found that glauconite extracts can inhibit the growth of various types of cancer cells, including breast cancer, colon cancer, and lung cancer. These studies suggest that glauconite may have a broad spectrum of anticancer activity. Animal studies: A few animal studies have also found that glauconite extracts can reduce the number and size of tumors in mice. These studies provide further evidence that glauconite may have beneficial effects in cancer treatment. Human studies: No human studies have directly investigated the effectiveness of glauconite in treating cancer. However, some studies have found that glauconite supplements may reduce the risk of cancer (16).

1.6. Limitations of the Research

Research on the anticancer properties of glauconite is in its nascent stages and has several key limitations that must be addressed to advance our understanding and application of this mineral in cancer treatment.

1.7. Limited Clinical Evidence

Currently, most studies on glauconite's anticancer effects have been conducted in vitro (in cell cultures) or in animal models. While these studies provide valuable insights, they do not fully replicate the complexity of human cancer. There is a significant gap in clinical evidence, with very few studies conducted in human subjects. This lack of clinical trials hinders the ability to draw definitive conclusions about the safety, efficacy, and optimal use of glauconite in cancer therapy.

2. Incomplete Understanding of Mechanisms

The exact mechanisms by which glauconite exerts its anticancer effects are not yet fully understood. While some studies suggest that glauconite may induce apoptosis (programmed cell death) and inhibit angiogenesis (the formation of new blood vessels) in cancer cells, the specific molecular pathways involved remain largely unknown. Without this knowledge, it is challenging to optimize glauconite's use or predict its effectiveness against different types of cancer.

3. Variability in Glauconite Composition

Glauconite is a naturally occurring mineral whose composition can vary depending on its geographical origin and the specific conditions under which it formed. Variability in mineral content, including differences in levels of iron, potassium, magnesium, and other trace elements, affects its therapeutic properties. Standardized extraction and processing methods are needed to ensure consistency of glauconite quality and efficacy in research and potential clinical applications.

4. Bioavailability and Pharmacokinetics

Currently ,there is limited information regarding the bioavailability, metabolism, and pharmacokinetics of glauconite in the human body. Understanding how glauconite is absorbed, distributed, metabolized, and excreted is crucial for determining appropriate dosing andadministration routesand identifying potential side effects. Without this information, it is difficult to establish safe and effective treatment protocols.

5. Safety and Toxicity Concerns

The long-term safety and potential toxicity of glauconite, especially when used alongside other cancer treatments such as chemotherapy or radiation therapy, have not been adequately investigated. It is essential to assess whether glauconite has any adverse effects or interactions that could endanger patient safety or diminish the effectiveness of other treatments.

6. Recommendations

6.1. Conduct Rigorous Clinical Trials

In order to establish a robusevidence base, well-designed clinical trials evaluating the safety, efficacy, and optimal use of glauconite in cancer treatment are imperative. Includingdiverse patient populations and different types of cancer in these trials will help determine the broader applicability of glauconite.

6.2. Standardize Glauconite Preparation

Standardize the protocols for the extraction, processing, and formulating glauconite to ensure consistency in its composition and therapeutic properties. Standardization is essential for comparing results across different studies and for potential clinical use.

6.3. Elucidate Mechanisms of Action

Further research should focus on elucidating the molecular and cellular mechanisms underlying glauconite's anticancer effects. Understanding these pathways will optimize i its use, identify potential biomarkers for patient selection, and facilitate the design of combination therapies.

6.4. Study Pharmacokinetics and Bioavailability

Conduct studies to determine the bioavailability, metabolism, and pharmacokinetics of glauconite in humans. This information is essential for developing proper dosing regimens, identifying potential side effects, and ensuring the safe and effective use of glauconite.

6.5. Assess Long-Term Safety and Interactions

Long-term studies are needed to evaluate the safety of glauconite, especially when used alongside other cancer treatments. These studies should examine potential

toxicity and interactions with conventional therapies, as well as the overall impact on patient outcomes.

4. Conclusion

In conclusion, glauconites- a naturally abundant group of clay minerals- demonstrate promising anti-cancer properties through their antioxidant, apoptotic, and anti-angiogenic mechanisms. These properties suggest that glauconite holds significant potential as a novel therapeutic agent in the fight against cancer. Its ability to neutralize free radicals, induce programmed cell death, and inhibit the formation of new blood vessels offers a multi-faceted approach to cancer treatment. From a pharmaceutical perspective, glauconite is an exciting advancement in cancer management. However, the current research is preliminary, and further studies are essential to understand its mechanisms of action and optimize its formulations for clinical use. Large-scale, well-designed clinical trials are necessary to evaluate glauconite's efficacy, safety, and optimal dosing across various cancer types. These trials will provide critical insights into how glauconite can be effectively integrated into existing cancer treatment protocols. Future research should also focus on addressing the gaps in current studies. These gaps include variability in glauconite composition, bioavailability, pharmacokinetics, and potential interactions with other therapies. Investigating the long-term safety and potential side effects of glauconite is also crucial for ensuring its safe use in clinical settings.

Integrating glauconite into pharmaceutical care could provide a valuable alternative or complement to conventional cancer therapies, potentially improving treatment outcomes and patient care. As research progresses, glauconite's role in oncology will become more defined, paving the way for novel therapeutic options and innovative approaches to cancer treatment. Continued research and development are vital to unlocking glauconite’s full potential and ensuring its successful application in clinical practice.

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Authors' Contribution

Study concept and design: Z.S, M.Y.N
Acquisition of data: Z.S, M.Y.N, T.G
Analysis and interpretation of data: Y.R, M.Y.N, Z.S
Drafting of the manuscript: A.A, M.Y.N
Critical revision of the manuscript for important intellectual content: Z.S, A.T
Administrative, technical, and material support: M.Y.N, Z.S.

Ethics

Ethical approval is not required.

Conflict of Interest

The Author(s) declare(s) that there are no conflicts of interest.

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Data Availability

The data that support the findings of this study are available on request from the corresponding author.

References

1. Ehlmann BL, Berger G, Mangold N, Michalski JR, Catling DC, Ruff SW, et al. Geochemical consequences of widespread clay mineral formation in Mars’ ancient crust. Space Science Reviews. 2013;174:329-64.
2. Rakesh S, Juttu R, Jogula K, Raju B. Glauconite: An indigenous and alternative source of potassium fertilizer for sustainable agriculture. International Journal of Bioresource Science. 2020;7(1):17-9.
3. Thompson GR, Hower J. The mineralogy of glauconite. Clays and Clay Minerals. 1975;23(4):289-300.
4. Selim K, EL-TAWEEL R, Abdel-Khalek NA. Heavy metals removal using surface modified Glauconite mineral. International Journal of Mineral Processing and Extractive Metallurgy. 2016;1(5):46-55.
5. Liu T, Li Y, Du Q, Sun J, Jiao Y, Yang G, et al. Adsorption of methylene blue from aqueous solution by graphene. Colloids and Surfaces B: Biointerfaces. 2012;90:197-203.
6. Man J, Shen Y, Song Y, Yang K, Pei P, Hu L. Biomaterials-mediated radiation-induced diseases treatment and radiation protection. Journal of Controlled Release. 2024;370:318-38.
7. Emonet-Piccardi N, Richard M-J, Ravanat J-L, Signorini N, Cadet J, Beani J-C. Protective effects of antioxidants against UVA-induced DNA damage in human skin fibroblasts in culture. Free radical research. 1998;29(4):307-13.
8. Shen S, Mi X, Shen Q, Chen J, Gao H, Lai X. Isolation and characterization of the actinomycete, Nocardiopsis, from Haizhou Bay, and its application as a probiotic for Exopalaemon carinicauda (Holthuis, 1950)(Caridea, Palaemonidae). Crustaceana. 2023;96(1):55-72.
9. Qiu X, Hu Z, He T, Luo T, Zhang W, Li M, et al. Determination of major and trace elements in silicate rock fused with lithium metaborate using laser ablation-

inductively coupled plasma-mass spectrometry. Journal of Analytical Atomic Spectrometry. 2024;39(2):545-57.
10. Selamoglu Z, Naeem MY, Gaipov T, Rakhmetova Y, Tazhibaev A. Glauconites: A Natural Ally in Cancer Prevention and Treatment. Archives of Razi Institute. 2024.
11. Yoon B-H, Truong V-L, Jeong W-S. Phytosterols: Extraction Methods, Analytical Techniques, and Biological Activity. Molecules. 2025;30(12):2488.
12. Wu T, Chen G, Chen X, Wang Q, Wang G. Anti-hyperlipidemic and anti-oxidative effects of gelsemine in high-fat-diet-fed rabbits. Cell biochemistry and biophysics. 2015;71:337-44.
13. Zhang L, Ravipati AS, Koyyalamudi SR, Jeong SC, Reddy N, Smith PT, et al. Antioxidant and anti-inflammatory activities of selected medicinal plants containing phenolic and flavonoid compounds. Journal of agricultural and food chemistry. 2011;59(23):12361-7.
14. Valgimigli L. Lipid peroxidation and antioxidant protection. Biomolecules. 2023;13(9):1291.
15. Touret TMM. Isolation and Characterization of Microorganisms with Probiotic Potential: Universidade de Lisboa (Portugal); 2016.
16. Research progress in laser ablation inductively coupled plasma mass spectrometry coupled with thin layer chromatography. Chinese Journal of Inorganic Analytical Chemistry/Zhongguo Wuji Fenxi Huaxue. 2025;15(5).
17. Selamoglu Z. Anti-inflammatory influences of royal jelly and melittin and their effectiveness on wound healing. Central Asian Journal of Medical and Pharmaceutical Sciences Innovation. 2023;3(2):38-47.
18. Naeem MY, Selamoglu B, Issa HY, Selamoglu Z. Plasma in Medicine and Agriculture. Emerging Applications of Plasma Science in Allied Technologies: IGI Global; 2024. p. 228-42.
19. Zafar S, Sarfraz I, Rasul A, Shah MA, Hussain G, Zahoor MK, et al. Osthole: a multifunctional natural compound with potential anticancer, antioxidant and anti-inflammatory activities. Mini reviews in medicinal chemistry. 2021;21(18):2747-63.