An overview of the biological activity of polyacrylamide hydrogels

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Abstract

Background: Polyacrylamide hydrogels have emerged as a versatile class of materials with considerable potential within the domain of biomedicine. These hydrogels, comprising crosslinked polyacrylamide polymers, exhibit distinctive properties that render them highly appealing for a wide range of applications in tissue engineering, drug delivery, wound healing, and regenerative medicine. **Objective:** This article provides a comprehensive overview of polyacrylamide hydrogels and their properties**. Discussion:** Furthermore, it delves into the interactions between these hydrogels and living tissues, evaluates their biocompatibility, and underscores their diverse applications within the realm of biomedicine. **Conclusion:** By comprehending the intricate biological behavior and inherent potential of polyacrylamide hydrogels, researchers and practitioners can effectively explore their application in the development of advanced biomedical technologies.

Keywords: Polyacrylamide, hydrogels, biological activity, application.

Polyacrylamide as artificial tissues

Numerous artificial tissue applications use polyacrylamide, a synthetic polymer (1-3). It is a very adaptable substance that can be handled in a variety of ways to produce artificial structures (4, 5). Tissue engineering, the creation of artificial skin, and other uses have all made use of it (6). The hydrogel type of polyacrylamide is used most frequently in synthetic tissues (7). A hydrogel is a substance made up of a web of polyacrylamide chains that are bonded together chemically (8-12). This polyacrylamide chain network creates a solid, gel-like substance that is very elastic and water-soluble. It is the perfect material for use in artificial tissues because of this characteristic (13).

Artificial tissues with characteristics like those of genuine tissues may be made using polyacrylamide hydrogels (14, 15). For instance, polyacrylamide can be utilized to produce synthetic skin with characteristics resembling those of real skin (16).

Polyacrylamide as an antibacterial agent

Polyacrylamide has grown in popularity as an antibacterial agent recently due to its efficacy in treating a number of bacterial infections (17-20). A gel-like material that may be utilized as an antibacterial agent has been made using the synthetic polymer polyacrylamide (21). This gel-like material has the capacity to attach to bacteria and create a barrier of defence that stops the germs from proliferating and spreading (22). Infections caused by bacteria that are resistant to conventional antibiotics can be effectively treated as a result (23).

Additionally, polyacrylamide can be used to reduce the number of bacteria present in a wound, allowing the body’s natural healing process to take over (24). This is due to the ability of the gel-like substance to form a protective barrier around the wound, preventing the bacteria from entering and spreading (25). Additionally, polyacrylamide can be used to reduce the number of bacteria present in a wound, allowing the body’s natural healing process to take over (26).

Antimicrobial activity of polyacrylamide

Polyacrylamide is a powerful antimicrobial agent that has been used in a variety of medical and industrial applications (27). In the medical field, polyacrylamide can be used to create an inert polymer coating on medical devices, such as catheters and needles that prevents the attachment of bacteria and other contaminants (28-30). Polyacrylamide has also been used to improve the shelf life of food products, as a preservative and to reduce microbial growth in fresh produce (31). Furthermore, polyacrylamide can be used to treat water to reduce the level of contaminants and prevent infections from occurring (32). Polyacrylamide has several advantages when used as an antimicrobial agent (33). It is non-toxic and non-sensitizing, meaning it does not cause any allergic reactions or other adverse reactions in humans (34). Additionally, it is highly effective at eliminating the growth of bacteria and other microbes (35).

Polyacrylamide as an anti-fungal agent

Polyacrylamide is a highly effective anti-fungal agent that has been studied extensively and proven to provide effective solutions to a wide range of fungal infections (36). This polymer is a synthetic material composed of acrylamide, an organic compound and an amide linker (37). It has multiple benefits due to its structural features, including its ability to bind to water molecules and form a gel-like network (38). This network has proven to be effective in trapping and eliminating microorganisms, including fungi (39). Polyacrylamide has been tested in multiple studies, with results showing its efficacy in treating fungal infections (40). In particular, it has been shown to reduce the spread of Candida albicans, a type of yeast that commonly causes fungal infections (41). Moreover, it has been found to reduce the growth of Aspergillus niger, a type of fungus that can cause respiratory infections (42).

The anti-fungal properties of PAM are attributed to its ability to interact with and bind to the fungal cell wall (43). This interaction causes the fungal cell wall to rupture, resulting in the death of the fungal cells (44). The anti-fungal properties of PAM can also be enhanced by adding a surfactant, which further reduces the surface tension of the PAM and allows it to penetrate deeper into the fungal cell walls (44).

Its efficacy has been demonstrated in both laboratory and clinical settings, making it a viable option for controlling the spread of fungal infections (45). The primary benefit of polyacrylamide is its ability to act as a barrier between healthy skin and fungus (34). It uniquely binds to fungal cells, preventing them from invading healthy tissue (46). Furthermore, it can absorb moisture and oils, making it difficult for fungal spores to establish colonies (47). In addition to being an effective anti-fungal agent, polyacrylamide has been used to treat skin ailments such as eczema and psoriasis (48). It can help to reduce inflammation and promote healing (49). Furthermore, it is relatively non-toxic, making it a safe alternative to some more traditional treatments (50).

Pharmaceutical benefits of polyacrylamide

The benefits of polyacrylamide, a widely used polymer matrix, in the pharmaceutical industry, are numerous and far-reaching (51). Polyacrylamide is used in the treatment of many medical conditions and is a common ingredient in many medications (52). One of the primary benefits of polyacrylamide is that it is a highly effective stabilizer, helping to reduce the effects of thermal and chemical degradation on drugs (53). By reducing drug degradation, polyacrylamide helps extend the shelf-life of medicines (54). This is especially beneficial for those medications that need to be kept in controlled environments to remain viable (55). Polyacrylamide has also been shown to be an effective adsorbent, capable of binding to several types of molecules (56). This property makes it a useful tool for removing unwanted substances from medicines, allowing for more precise control over the composition of the final product (57).

Anti-Cancer activity of Polyacrylamide

Polyacrylamide is a water-soluble synthetic polymer with a wide range of industrial and medical applications (2-10). It has recently been found to have anti-cancer activity, with the potential to be used in cancer therapy (58). Studies have shown that polyacrylamide can bind to cancer cells and disrupt their growth and replication, making it a promising agent in the fight against cancer (59). Additionally, it has been shown to stimulate the body’s natural immune system to fight off cancer cells by activating cell-mediated immunity (60). The anti-cancer activity of polyacrylamide is thought to be due to its high biocompatibility and the fact that it is non-toxic and non-immunogenic (61). Its chemical properties also make it a good candidate for drug delivery systems (61). Recent studies have suggested that polyacrylamide can be used to deliver drugs directly to cancer cells, making it a potentially effective therapy for certain types of cancer (62).

Polyacrylamide is a type of synthetic polymer that has been studied for its potential anti-cancer activity (63). It is a water-soluble polymer composed of acrylamide monomers that are connected by covalent bonds (64). It has many properties that make it an attractive choice for use in cancer therapies. First, it is known to be non-toxic and biodegradable, making it safe to use in the body (65). Additionally, it has a high molecular weight, which makes it capable of penetrating cell membranes and entering the target cancer cells (66). Once inside the cells, it has been shown to have several anti-cancer activities (67). It has been found to reduce the size of tumors and reduce the growth of cancer cells (68). Finally, it has also been shown to inhibit the growth of new blood vessels that supply the tumor with nutrients and oxygen, thereby starving the tumor of the nutrients it needs to survive and flourish (69).

Clinical application of polyacrylamide

Polyacrylamide is a type of polymer that has garnered considerable attention in recent years for its potential clinical applications (70). Its varied properties, such as its ability to hold large amounts of water, provide a variety of therapeutic benefits (70). For example, polyacrylamide hydrogels are used as a tissue substitute, a drug delivery system, and a scaffold for cell growth (71). The clinical application of polyacrylamide is not limited to its use as a tissue replacement (72). Its unique properties make it an ideal material for a variety of medical treatments, such as wound healing, burn treatment, and skin rejuvenation (72). Its biocompatibility allows it to be used in the body without causing any adverse reactions (73). In addition, polyacrylamide can be used to enhance drug delivery by providing a way to control the release rate of drugs, which can improve the effectiveness of drug therapy (74).

Polyacrylamide in biochemistry

Polyacrylamide is a versatile polymer with a wide range of applications in biochemistry (75). It is a linear, water-soluble polymer that can be used to separate, purify, and analyze molecules, including proteins, nucleic acids, and carbohydrates (76). Polyacrylamide is also used to study the structure and function of proteins, as well as to study the interactions between proteins and other molecules (77).

Polyacrylamide is used in various biochemical techniques, such as gel electrophoresis, chromatography, and immunoassays (75). Gel electrophoresis is a technique used to separate molecules based on their size and charge (78). Chromatography is a technique used to separate and analyze molecules based on their size, charge, and affinity for a stationary phase (79). Polyacrylamide is used in both affinity and size-exclusion chromatography (79). Immunoassays are used to detect and measure specific molecules, such as hormones, enzymes, and antibodies (80). Polyacrylamide is used to immobilize antibodies and to separate the bound and unbound molecules (81).

Polyacrylamide is also used in biotechnology, such as in the production of recombinant proteins (82). Polyacrylamide is used to purify and concentrate proteins and study their structure and function (83). Polyacrylamide can also be used to immobilize enzymes, which are used in biocatalysis, and to study the interactions between proteins and other molecules (84).

Overall, polyacrylamide is an essential tool in biochemistry, with applications in gel electrophoresis, chromatography, immunoassays, biotechnology, and more. It is a versatile polymer that can be used to separate, purify, and analyze a wide range of molecules.

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الخلاصة

الخلفية: ظهرت هيدروجيلات البولي أكريلاميد كفئة متعددة الاستخدامات من المواد ذات الإمكانات الكبيرة في مجال الطب الحيوي. تتألف هذه الهيدروجيلات من بوليمرات البولي أكريلاميد المترابطة، وتتمتع بخصائص مميزة تجعلها جذابة للغاية لمجموعة واسعة من التطبيقات في هندسة الأنسجة وتسليم الدواء وشفاء الجروح والطب التجديدي. الهدف: يوفر هذا المقال نظرة شاملة على هيدروجيلات البولي أكريلاميد وخصائصها. المناقشة: بالإضافة إلى ذلك، يتناول التفاعلات بين هذه الهيدروجيلات والأنسجة الحية، ويقيم توافقها الحيوي، ويسلط الضوء على تطبيقاتها المتنوعة في مجال الطب الحيوي. الاستنتاج: من خلال فهم السلوك البيولوجي المعقد والإمكانات الفطرية لهيدروجيلات البولي أكريلاميد، يمكن للباحثين والممارسين استكشاف تطبيقها بفعالية في تطوير التقنيات الطبية المتقدمة.

الكلمات المفتاحية: بولي أكريلاميد ، الهلاميات المائية ، النشاط البيولوجي ، التطبيق.

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