

Bletilla Striata Polysaccharide as Promising Multifunctional Biomedical Materials

Abstract

Bletilla striata polysaccharide (BSP) is a type of natural hydrophilic polymer that has been around for more than 1500 years and is derived from the plant. Due to its potential pharmacological activities, it has recently piqued the interest of researchers working in clinical transformation, material design, and basic research. All the more critically, BSP as promising biomaterials displays particular physicochemical properties (for example solvency, thickness, and film-framing capacity), biocompatibility, biodegradability and primary modifiability. Unmodified BSP is normally made into hydrogels, wipes, micro needles, films and lyophilized wafers alone or formed with different materials, though synthetic changed BSP is basically ready into micelles, microspheres, nanoparticles, nanofibers and natural frameworks. The various BSP-based biomaterials have high research and application values in material science and biomedical engineering and can be widely used in wound healing, targeted drug delivery, and tissue engineering. In this, the exploration is begun with the planning, portrayal and construction properties of BSP. BSP-based biomaterials before and after modification are summarized and emphasized with applications perspectives. Additionally, the ongoing difficulties and future viewpoints of BSP-based biomaterials are likewise featured. This review is intended to aid in the comprehension of natural biopolymers and provide guidelines for expanding the use of BSP as multifunctional materials in biomedicine.

Keywords: Biohybrid materials • Deproteinization • Tissue engineering

Introduction

The development of multifunctional BSP-based biomaterials still faces several fundamental issues, including the standardization of raw material selection and preparation, according to the available literature. The connection between the properties of the prepared biomaterials and the BSP's molecular weight, structure, and biological activity; and the problems with market industrialization and clinical transformation. Then again, the advancement of nanotechnology, material plan, creative details, regenerative medication, joined with multi-disciplinary improvement has opened up new roads and open doors for BSP science. As a result, the purpose of this review was to provide a synopsis of the physicochemical properties, the method of preparation, the pharmacological activity, the biosafety of BSP, and the characteristics of various BSP-based biomaterials. Theranostic applications of BSP in a variety of forms, such as wound healing, targeted drug delivery, and biological tissue engineering, were emphasized in particular. Last but not least, we discussed our thoughts regarding the biomaterials based on BSP's challenges of the present and potential of the future.

The extraction and purification phases of the BSP preparation process are depicted in detail in Figure. 2b. In the previous advances, various extraction methods have been created, including high temp water extraction (HWE), basic extraction (AE), compound helped extraction (EAE), infrared-helped extraction (IRAE), ultrasonic-helped extraction (UAE), and ultrasonic-microwave synergistic extraction (UMSE). Lists the advantages and disadvantages of these approaches. Among them, the conventional extraction techniques (HWE and AE) accomplish relative high return. However, they have a number of flaws, including poor selectivity, a long

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extraction time, a wide extraction range, easy leaching of impurities, and easy decomposition of active ingredients. As a result, they are unable to meet the requirements of modern production because they have a direct impact on the extracted BSP's quality, production efficiency, and financial benefit.

To effectively extract traditional Chinese medicine, novel extraction technologies (such as EAE, IRAE, UAE, and UMSE) are proposed and implemented in the face of such adversity. Kong et al., for instance utilized papain to get rid of the protein impurities that were present in the crude polysaccharide extract. Under the following conditions, the results revealed that the highest purity of 97.0 percent of BSP was achieved: enzyme concentration of 8-10 mg/g substrate, pH of 7.0-7.5, temperature of 45-50°C, and duration of enzymolysis of 120-150 minutes. The method demonstrated high specificity, high purity, simple operation, and no damage to the active ingredients' original structure or biological activity under mild reaction conditions. Qu et al. used a Box-Behnken-based IRAE design to find that the extraction yield of BSP was 43.95 ± 0.26 % under the states of extraction temperature of 75 °C, water-strong proportion of 53 ml/g and extraction season of 2.5 h [1-5].

Discussion

The creators accepted that IRAE had high extraction proficiency and no impact on the natural movement of parts, which could altogether work on the security of BSP in the extraction cycle, while UAE was considered as the best extraction strategy with the best return (49.90 %), aside from those requiring explicit hardware and including slight debasement of water-solvent polysaccharides. Furthermore, under the interaction states of fluid material proportion of 20:1 ml/g, drenching season of 6 min and microwave force of 200 W, Cai et al. discovered that BSP's extraction yield could be increased to 6.98 percent 0.19 percent using UMSE in just 5 minutes. It was recommended that UMSE was better than the single extraction procedures by coordinating the integral benefits and taking advantage of synergistic impacts.

It ought to be seen that BSP separated by the greater part of the previously mentioned strategies has a place with the blended unrefined items, and their creation, sub-atomic weight and fundamental compound construction are not satisfactory, which should be additionally

refined before biomedical applications. To ensure that the polysaccharide extracts are highly purified, the necessary steps should be taken to eliminate impurities like proteins. Everyone is aware that deproteinization is the primary step in the purification of crude BSP. Sevag reagent (dichloromethane) is currently: The free proteins from BSP are typically removed using n-butanol (at a ratio of 4:1, v/v). Utilizing a variety of adsorbents and eluents in column chromatography, BSP is then purified. In subtleties, particle trade chromatographies including DEAE-cellulose section is reasonable for the division of different polysaccharides (nonpartisan polysaccharides from acidic ones) with a salt slope for elution, while gel filtration (Sephadex G segment) is by and large pertinent to the purging of BSP fragments as per the distinctions of sub-atomic weight. It is important to note that mucopolysaccharides do not typically respond well to gel filtration. For gradient elution, viscose BSP should first be loaded into ion exchange chromatography with the exchange agent DEAE-cellulose, and the collected fraction was further purified on a Sephadex G column and eluted with distilled water. By elution, the separated fraction of each BSP segment in each molecular weight can be obtained after combining a single peak.

It is evident that there are still some flaws in the extraction and purification of BSP, which makes it impossible to produce BSP industrially from *B. striata*. Therefore, effective extraction and purification technology must be developed for industrial BSP preparation. With the ceaseless advancement of synthetic partition innovation, film detachment innovation displaying the attributes of minimal expense, green, and energy saving is steadily evolved. That is, microfiltration/ultrafiltration membrane separation technology divides the BSP of *Da* into various molecular weight segments and adjusts the pressure. As a result, this method can be used to quickly and effectively separate the environment while preparing BSP [6-10].

Conclusion

BSP is thought to be biosafe because it is a polysaccharide that comes from plants. BSP's low toxicity, low irritation, good biocompatibility, and degradability have been confirmed by numerous pioneering studies, indicating very promising development prospects. Up to now, the poisonousness, secondary effects and unfavorable responses from BSP have seldom

been accounted for. In particular, the acute toxicity test in mice and the vaginal irritation test in rabbits demonstrated, from a toxicology standpoint, that BSP was safe and reliable as a medicinal excipient at early stages. From that point forward, Zhang et al. administered BSP orally to mice for the acute toxicity test at concentrations of 1, 2, 4, and 10 g/kg body weight, respectively. The findings demonstrated that BSP would not result in any abnormalities or deaths, and female mice had a higher oral safety profile when the LD50 was greater than 10 g/kg body weight. In the skin toxicity study of BSP, it was also discovered that the substance did not cause irritation to rabbit skin, a skin allergy to guinea pig skin, or adverse effects on human skin. Moreover, in view of the CCK-8 examine, BSP was additionally ended up being excluded in cytotoxic or inhibitory impacts on the development of IEC-18 cells at the portion of 25, 50 and 100 µg/ml. BSP microspheres were also found to be highly biosafe for mouse fibroblasts (L929) and human umbilical vein endothelial cells (HUVEC) during any MTT assay incubation period.

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