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Short Communication

An Update on Biomaterials as a Pharmaceutical Excipient in Drug Delivery Systems and its Pharmaceutical Applications

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Abstract

Biopolymers isolated from natural sources may be used as novel excipients having the polymeric nature. These isolated biopolymers have excellent bio-retardant, bio-stabilizer and bio-adhesive property. It has excellent film forming ability, and bio-stability properties. The isolated bio-polymers have excellent drug release rate controlling abilities. Since these are natural and edible in nature, these are biodegradable in nature and may be used as an alternative to standard synthetic and semi synthetic polymers.

Keywords: Polymers; Biopolymer; Biodegradable; Natural; Economical

Introduction

Polymers are an important component in the development of medication delivery systems. These have been demonstrated to be the backbone of the drug development process. These play an important role in the development of innovative drug delivery systems that can handle a variety of complexities [1]. These are employed to keep the drug's look under control when it's needed. Hydrophilic and lipophilic polymers are the best choices for achieving optimal conveyance in a regulated way at the desired locations. These manufactured and semisynthetic polymers are created using a variety of chemical processes and purifying methods. These are pricey since they are prepared by various unit processes.

Various investigations are being conducted on a daily basis in order to prevent the distinctive, physiological, and rational concerns associated with synthetic and semisynthetic polymers [2]. As a result, an alternative to synthetic and semisynthetic polymers is being researched for interest, probability, and any residual benefits with the fewest negative consequences for the environment and human physiology. Biopolymers, as an alternative to artificial and semisynthetic polymers, have piqued researchers' interest by employing cost-effective methods. Biopolymers are new, nimble, and sharp polymers derived from a variety of natural sources. Biopolymers derived from natural sources have the potential to be used as innovative polymeric excipients.

Bio-retardant, bio-stabilizer, and bio-adhesive characteristics are all excellent in these isolated biopolymers [3]. These have excellent film-framing capabilities as well as biocompatibility. The separated bio-polymers provide excellent control over medication release rates. Because they are biodegradable, they can be used as an alternative to conventional synthetic and semisynthetic polymers [4]. The isolated biopolymer, which has important biodegradable, adhesive, film forming ability, and retardant properties similar to ordinary polymers, could be used to build innovative drug delivery systems.

Biopolymers as a novel biomaterial

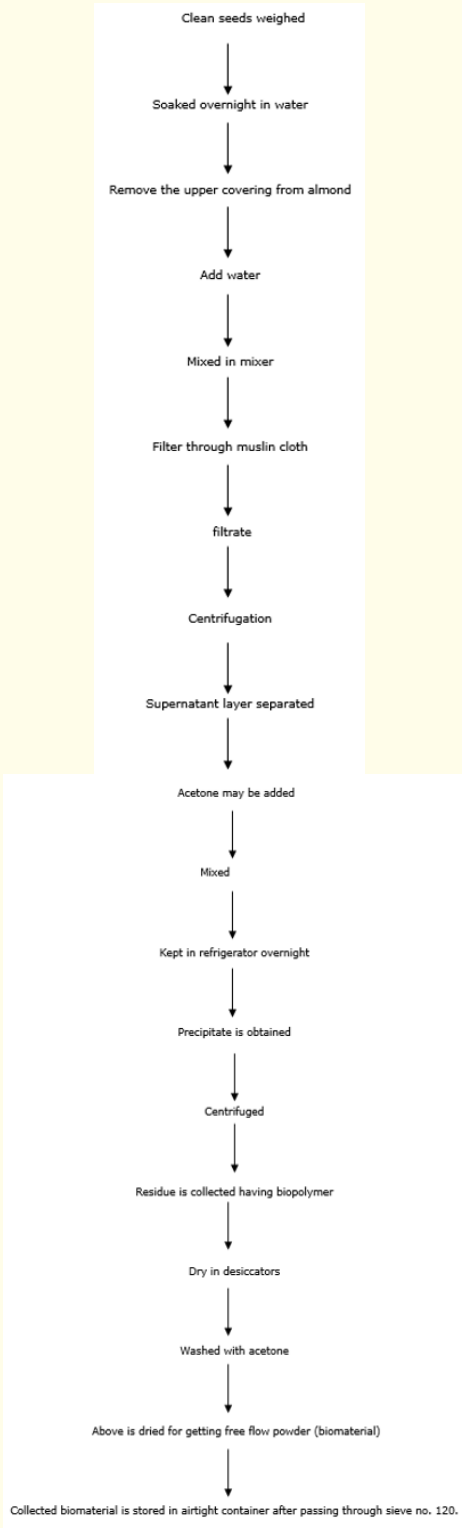
Biopolymers isolated from natural sources may be used as novel excipients having the polymeric nature [5]. These isolated biopoly-

mers have excellent bio-retardant, bio-stabilizer and bio-adhesive property. It has excellent film forming ability, and bio-stability properties [6]. The isolated bio-polymers have excellent drug release rate controlling abilities. Since these are natural and edible in nature, these are biodegradable in nature and may be used as an alternative to standard synthetic and semi synthetic polymers [7].

The isolated biopolymer shows the significant biodegradable, adhesive, film forming ability and retardant properties which are similar to properties of synthetic standard polymers [8]. They have most of the novel properties which can be safely used for drug delivery. The biopolymers are isolated from the natural sources which are economical. The synthetic polymers are prepared by using the different chemical treatment which has many harmful effects. The biopolymers have unique novel properties [9]. The biopolymers may be used as for controlling the dug release in sustained way, controlled way, extended way, prolonged way and thus are used as drug carrier bio-excipients [10]. Since they are having natural origin and biodegradable in nature can be sued for minimizing the unwanted effects with synthetic polymers.

General Isolation procedure from seeds

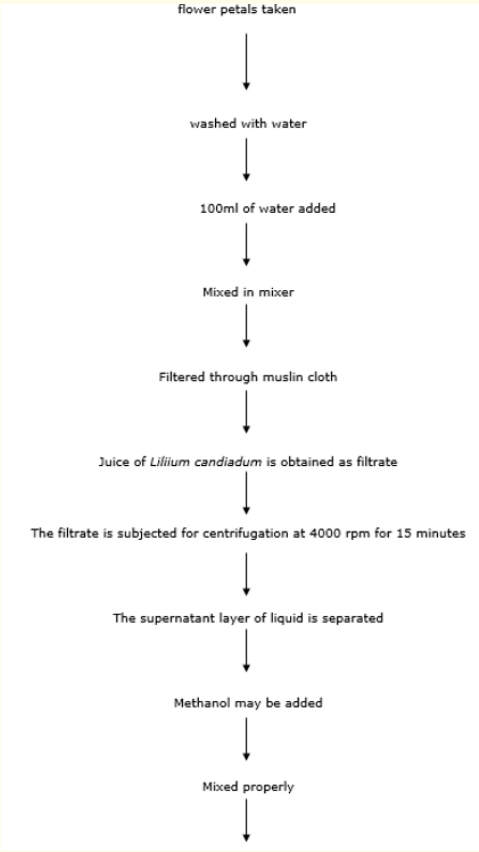
The seeds are soaked overnight in purified water. The upper covering of almond may be then removed. Small quantity of purified water is added to this and then this blend is properly mixed in mixer. This slurry is filtered with the help of muslin cloth and thus the biomaterial is separated by filtration. The resultant is obtained as filtrate. After that the mixture is subjected to centrifugation at about 4000 rpm for and then the resultant supernatant layer is properly separated and taken. Then acetone or other organic solvents may be added in the ratio of 1:1 and mixed properly. This mixture is kept in refrigerator overnight at specified temperature and the solution is again centrifuged at specified rpm for specified time. Residue is collected having biomaterial and dried in desiccators for overnight. This residue of biomaterial may be washed with acetone or other washing solvents and the biomaterial is dried naturally for getting fee flowing powder. The collected biomaterial is stored for further use in airtight containers after passing through sieve no. 120. The schematic flow chart of isolation procedure has been summarized in flow chart 1. This procedure is repeated for six times and optimized and then percentage yield is calculated [11].

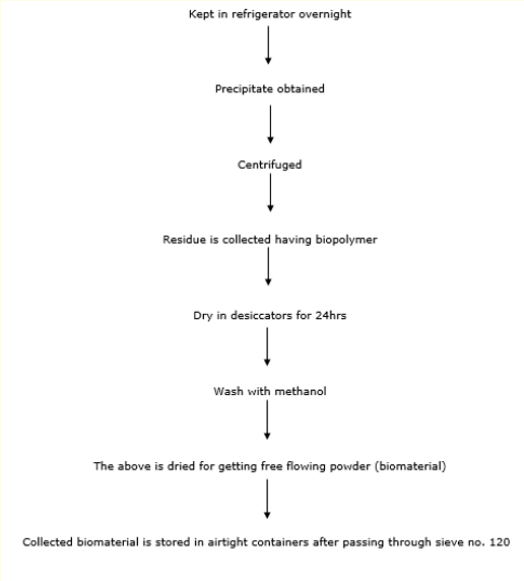


Flowchart 1: Isolation of biomaterial from seeds.

Isolation of biomaterial from flowers

The fresh flower is taken and petals are washed with purified water. The petals of was then removed properly. The purified water is added to this and then the blend in mixer. This mixture is filtered with using the muslin cloth and thus the biomaterial is separated by filtration. The resultant is filtered and juice is obtained as filtrate. After that the filtered mixture is subjected for centrifugation at 4000 rpm for 15 minutes and then after centrifugation the supernatant layer is properly separated. Methanol may be then added and mixed properly. This mixture is kept in refrigerator overnight and the product obtained is subjected for centrifugation at 4000 rpm. Residue is collected having biopolymer and dried in desiccators. This residue of biomaterial is washed with methanol and the biomaterial is dried naturally for getting free flowing powder. The collected biomaterial is stored for further use in airtight containers after passing through sieve no. 120. The schematic flow chart of isolation procedure has been summarized in flow chart 2. This procedure may be repeated for six times and optimized and then percentage yield is calculated [11-14].





Flowchart 2: Isolation of biomaterial from flower.

Updates on researches on biopolymers

According to Madhav [10], Arachis hypogea seeds can be used to make drug-loaded bio-microdwarfs using an unique biopolymeric material. The goal was to create a biomaterial with a high processing benefit that would give information about cost-effective scale-up techniques. The drug's release rate is controlled by the biopolymer, which was isolated and described for its inherent features [15,18].

Gupta., *et al*. (2011) described a method for isolating a novel bio-dispersant from *Cicer arietinum* seeds and preparing Escitalopram granules containing the bio-dispersant. Bio-dispersant was obtained by treating Cicer arietinum seed extract with double distilled water and ethanol, then collecting and analyzing the bio-dispersant for physicochemical parameters such as color, odor, particle size, shape, solubility, and IR spectrum analyses. Escitalopram granules were made with the help of medicine, lactose, bio-dispersant, bio-binder, and other processing agents. Six distinct formulations were created, each with a different concentration of bio-dispersant and bio-binder [18].

Tangri., *et al*.. (2012) defined an approach for the description and evaluation of atorvastatin supported delivery tablets by using

biomaterial as a novel fastener for tablet design. The fruit pulp of Artocarpus heterophyllus was extracted and processed on the basis of financial interaction for the isolation of biomaterial. Different physical and chemical characterizations were performed on the isolated biomaterial. Color, odor, chemical testing for biochemical composition and spectral analysis are all examples of spectral analysis. The three atorvastatin-stacked preparations, FA1-FA3, were created using different drug-biopolymer proportions of 1:1, 1:3, and 1:5, as well as diluents such as starch, powder, and lactose [19].

According to Erasmus., *et al*.. (2003), wheat grains can also be used as a horticultural raw material that is high in biopolymers. Biopolymers such as starch, protein, non-starch polysaccharides, and lipids are abundant in oat grains. For the necessary extraction of biopolymers, dry processing, wet processing, or a combination of both can be used. Dry milling is a method of separating grain into its anatomical components. Certain biopolymers, such as endosperm flour, which contains about 80% starch, can be used to enrich anatomical components [23].

Madhav., *et al*.. (2011) described a novel biomaterial derived from the unripe pulp of Artocaropus heterophyllus, as well as the evaluation of its profile emulsifying capacity using escitalopram stacked emulsions. Biomaterial was isolated from unripe natural product mash using a cost-effective method. It was investigated for physico-chemical characteristics such as colour, odor, and taste, as well as spectral analysis. Four layered medicine emulsions were created. Escitalopram was used as a model medication for emulsion preparation. The created emulsions were tested for globule size, pH, centrifugation impact, thickness, surface strain, creaming, freezing and defrosting cycles, and in-vitro release. The separated biomaterial's IR spectra revealed the existence of soaking hydrocarbons, an aromatic ring, and a tertiary alcohol group [20].

Apart from active pharmaceutical ingredients, Singh (2011) discussed the numerous components involved in pharmaceutical formulation creation. Due to its impact on dosage form design and concentrated on drug delivery systems, excipient innovation has recently become the focal point of drug conveyance research. Biopolymers have been popular as excipients in research because of their low toxicity, biodegradability, stability, and renewable nature. Some of the most often utilized biopolymers as excipients in the design of pharmaceutical drug delivery systems have been discussed [10].

According to Velde., *et al*.. (2002), knowing the attributes of the available polymers is necessary before commencing the design process in order to determine the most reasonable framework polymer. It was investigated in order to provide information on the most reasonable property of a variety of biodegradable polymers. In comparison to the conventional polymer, the knowledge is widely scattered across various sources and is extremely scarce. Thermoplastic pultrusion with flax as a support is another application that has been considered [24].

The biopolymer was obtained from Tapoica sago by Singh., *et al*.. (2019). It was examined for different factors such as viscosity, pH, conductivity, and other physical qualities after isolation. The presence of sugar and proteins in the biopolymer was also tested. The sequestered biopolymer was also characterized using conventional techniques including as FTIR. For cutaneous delivery, the isolated biopolymer was employed to make a bio-gel filled with curcumin. It was determined that employing a novel isolated biopolymer form sago as a novel retardant cum stabilizer, the curcumin loaded biogel can be effectively employed for wound treatment.

Sushant et a., 2021 isolated a new biopolymer from Juglans regia to create a phenytoin-loaded bio-nanosuspension. For the formulations PJ1-PJ7, different ratios of phenytoin and bio-polymer. The spread ability test, pH percent entrapment efficacy, bio nanoparticles size in bio-nanosuspension, zeta potential, stability study, and in-vitro drug release study were all performed on the bio-nanosuspension. On the basis of the above evaluation parameters, the formulation PJ2 with a 1:1 drug biopolymer ratio was judged to be the most stable bio-nanosuspension. In 36 hours, the best formulation, PJ2, showed up to 86.56 percent 3 drug release. Using an isolated biopolymer with a unique stabilizer cum retardant capability, the bio-nanosuspension was proven to be stable and safe for the delivery of nanosized phenytoin [22].

The goal of this study was to use a new biopolymer from Juglans regia to create a phenytoin-loaded bio-nanosuspension. For the formulations PJ1-PJ7, different ratios of phenytoin and biopolymer [21]. The spread ability test, pH percent entrapment efficacy, bio nanoparticles size in bio-nanosuspension, zeta potential, stability study, and in-vitro drug release study were all performed on the bio-nanosuspension. On the basis of the above evaluation parameters, the formulation PJ2 with a 1:1 drug biopolymer ratio was judged to be the most stable bio-nanosuspension. The best formu-

lation, PJ2, produced considerable satisfying results for various evaluations, with t 50% of 18.09 hours and t 80% of 29.77 hours, respectively, and a r2 value of 0.9970. The best formulation, PJ2, had an 86.56 percent 3 drug release rate in 36 hours.

The goal of this review is to highlight the novelistic qualities of bio-excipients extracted from many common natural sources such as legumes, seeds, leaves, vegetables, bits, roots, barks, and so on, and to evaluate the likelihood in a pharmaceutical delivery system. The biomaterials were subjected to several physicochemical tests as well as analytical examinations such as UV, FT-IR, Mass, and 1H NMR. The restricted biomaterial was discovered to be polymeric in nature, with a wide range of useful features. The biomaterial isolated from various sources, based on its inbuilt polymeric qualities, can be used as an alternative to readily available standard polymers at an exceptionally efficient and cost-effective scale. The isolated biopolymer had fascinating polymeric characteristics similar to those found in ordinary polymers. By examining several physico-substance properties, the isolated biomaterial from natural sources revealed specific inbuilt polymeric features. As we all know, there are a variety of polymers available that are frequently used in the development of new medications. Detached biomaterials derived from natural sources, on the other hand, have revealed unique features like as biodegradability, bio-retardant, bio-adhesive, film forming ability, and so on [21].

Properties of novel biopolymer

- Biodegradable
- Biocompatible
- Excellent bio-retardant property
- Bio-stabilizer
- Natural
- Economical
- Environmental friendly
- Excellent film forming ability
- Excellent stability

Bio-degradable

In terms of degradation, biodegradable polymers have a significant advantage over nonbiodegradable polymers. Because biodegradable polymers are generally obtained from natural sources, they are usually referred to as "biopolymers." In nature, biopolymers are biodegradable (Nalini, 2010).

Bio-compatible

- In comparison to other polymers, natural biopolymers have unique properties that make them promising building blocks for biocompatible conductors, such as biocompatibility.
- In the world of biomedical applications, biocompatible polymers are garnering a lot of attention. The word "biocompatibility" refers to a polymer's appropriateness for exposure to the human body and bodily fluids. Biocompatible polymers are both synthetic (man-made) and natural materials that work in close proximity to biological systems or with live cells [16].

Excellent bio-retardant property

Biopolymers have proved that they can be employed in the design and development of innovative medication delivery systems as medical research has progressed. These naturally isolated biopolymers have been utilized to regulate medication release in a long-term manned to the target. These could be used to direct the medicine to the desired location [17].

Bio-stabilizing property

It has been discovered that biopolymers extracted from natural sources can be used to stabilize various innovative formulations such as nano-suspension and nano-emuslions. As we all know, these formulations require a lot more stabilization than normal formulations. As a result, their unique qualities could be employed to stabilize these less stable liquid compositions [9].

Natural

Natural biopolymers have a high level of bioactivity and biocompatibility. Natural/biopolymers, as opposed to manufactured polymers, are considered environmentally friendly materials. Biopolymers have the added benefits of being biocompatible and biodegradable [20].

Economical

Cost effectiveness, environmental friendliness, and user-friendly materials are all advantages that naturally obtained biopolymers have over chemically created synthetic polymers. Biopolymers provide significant social, economic, and environmental advantages over synthetic polymers [17].

Environmental friendly

Mixes of various types and sources of biological materials, known as biopolymers, such as starch, cellulose, chitosan, zein, and gelatin, could be used as a solution to address and resolve these difficulties [19].

Excellent film forming ability

A solution could be mixes of diverse types and sources of biological materials, called biopolymers, such as starch, cellulose, chitosan, zein, and gelatin, which gradually replace synthetic polymers to address and resolve these challenges [20].

Excellent stability

Biopolymers offer a unique feature that can be used to improve the stability of an unstable composition. The bio-stabilizing property is a fantastic trait for keeping compositions stable. Because of their inertness, they are also stable due to their novelty [21].

Conclusion

Therefore, a substitute for synthetic and semi-synthetic polymers that has potential, interest, and any residual benefits with the fewest negative effects on the environment and human physiology is being researched. Biopolymers are brand-new, skilled, and cutting-edge polymers that have been extracted from numerous uncomplicated sources. It is possible to use biopolymers that have been obtained from natural sources as innovative excipients with a polymeric nature. Excellent bio-retardant, bio-stabilizer, and adhesive capabilities can be found in these isolated biopolymers. These offer excellent biocompatibility and film framing capabilities. The isolated bio-polymers are excellent in regulating the rate of drug release. Since they can be used as an alternative to commonly manufactured synthetic and semi-synthetic polymers which are biodegradable.

Bibliography

1. Baichwal MR. "Polymer films as drug delivery systems". In: Advances in drug delivery systems. Bombay MSR Foundation (1985): 136-147.

2. Dawood NM. "Formulation and characterization of lafutidine nanosuspension for oral drug delivery system". *International Journal of Applied Pharmaceutics* 10 (2018): 20-30.

3. Madhav NVS and Shankar MSU. "A novel smart mucoadhesive biomaterial from *Lallimantia royalena* seed coat". *Journal of Science Asia* 37 (2011): 69-71.

4. Madhav NVS and Singh K. "Smart ungual biopenetrant from the roots of Beta vulgaris". *Journal of Applied Pharmaceutical Research* 5.2 (2017): 21-26.

5. Madhav NVS and Tangri P. "Formulation and evaluation of zidovudine bio-micro dwarfs using a novel bio muco resident from Artocarpus heterophyllus". *International Journal of PharmTech Research* 3 (2011).

6. Madhav NVS and Yadav AP. "A novel translabial platform utilizing bioexcipients from Litchi chinensis for the delivery of rosiglitazone maleate". *Acta Pharmaceutica Sinica B* 3 (2013): 408-415.

7. Madhav NVS and Yadav AP. "Development and evaluation of novel repaglinide biostrips for translabial delivery". *International Research Journal of Pharmacy* 4 (2013): 198-202.

8. Madhav NVS and Pangatey P. "Indian Patent: Development of flexy bio- adhesive film loaded with nanosized zidovudine for brain specificity via novelistic soft palatal route". (2013).

9. Madhav NVS and Raina D. "Formulation and evaluation of duloxetine loaded bio-nanosuspension for brain specificity via acoustic meatus". *SOJ Pharmacy and Pharmaceutical Science* 4.1 (2017): 1-5.

10. Madhav NVS and Singh B. "A smart approach for delivering of nanosized olanzapine using piper betel biopolymer rate controlling flexi films for transvermillion delivery". *Asian Journal of Nanoscience* and *Materials* 02 (2019): 314-326.

11. Madhav S and Singh K. "Smart ungual biopenetrant from the roots of Beta vulgaris". *Journal of Applied Pharmaceutical Research* 5.2 (2017): 21-26.

12. Martin A. "Physical, Chemical Principles in the Pharmaceutical Sciences". 3rd ed. Varghese Publishing House, Bombay (2001).

13. Mohanraj VJ and Chen Y. "Nanoparticles □ A Review". *Tropical Journal of Pharmaceutical Research* 5 (2006): 561-73.

14. Muller. "Nanosuspensions as particulate drug formulation in therapy rationale for development and what we can expect for the future". *Advances in Drug Delivery* 47 (2001): 3-19.

15. Nilani P. "Formulation and Evaluation of Polysaccharide Based Biopolymer - an Ecofriendly Alternative for Synthetic Polymer". *Journal of Pharmaceutical Sciences and Research* 2.3 (2010): 178-184.

16. Ojha A and Madhav NVS. "A novel potent muco- bioadhesant polymer from seeds of Ricinus communis". *World Journal of Pharmaceutical Sciences* 3 (2014): 2154-2165.

17. Satheesh Madhav NV and Tangri P. "Design and evaluation of insulin loaded Bio- Flexy films for trans-soft palatal to brain delivery". *International Journal of Therapeutic Applications* 4 (2012): 10-18.

18. Subrahmanyam CVS and Thimma Setty J. "Laboratory Manual of Physical Pharmaceutics". 2nd ed. Vallabh Prakashan, New Delhi (2002): 169-174.

19. Tyagi Y and Madhav NVS. "Design selegiline loaded bio-nano-suspension for the management of depression using novel bio-retardent from Manilkara zapota". *Drug development and in Industrial Pharmacy* 45 (2019): 1351-1360.

20. Varshney S and Madhav NVS. "Smart approach for preparing nanosized topiramate loaded bio-flexy films using former from piper nigrum and screening its *In-vitro* performance". *Nanomedicine and Nanotechnology* 3.3 (2018): 000147.

21. Zhang J. "Preparation of amorphous cefuroxime axetil nanoparticles by controlled nanoprecipitation method without surfactants". *International Journal of Pharmaceutics* 323 (2006): 153-163.

22. Kumar S., *et al*. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

23. Erasmus C and Taylor JRN. "Large-scale extraction of cereal biopolymers". In: Afripro, Workshop on the Proteins of Sorghum and Millets: Enhancing Nutritional and Functional Properties for Africa. Paper 16. Conference proceedings published online at afripro.org.uk. (2003).

24. Velde KV and Kiekens P. "Biopolymers: overview of several properties and consequences on their applications". *Polymer Testing* 21 (2002): 433-442.

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