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Open Access REVIEW

Interpreting crosslink polymeric film of development of sodium alginate tragacanth for controlled delivery of ciprofloxacin

[1]*Anchal Singh, [2]Dr. Prashant Kumar Singh

[1*]Research Scholar, Faculty of Pharmaceutical Sciences, Rama University, Uttar Pradesh, Kanpur
[2]Associate Professor, Faculty of Pharmaceutical Sciences, Rama University, Uttar Pradesh, Kanpur

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Corresponding author:
Anchal Singh
*Research Scholar, Faculty of Pharmaceutical Sciences, Rama University, Uttar Pradesh, Kanpur
Email id: anchalsingh34000@gmail.com

ABSTRACT

In the fields of biotechnology, agriculture, gene therapy, wound healing, and controlled drug delivery, a number of polymeric films have been employed as drug carriers in recent years. The present study was based on the interpreting crosslink polymeric film of development of sodium alginate tragacanth for controlled delivery of ciprofloxacin. Sodium alginate (SA), and tragacanth were purchased from the local chemical shop, Kanpur. Ciprofloxacin was purchased as Ciplox tablets from the Cipla Pvt Ltd. All chemicals were of analytical grade. Soluble ciprofloxacin was added to a pharmaceutical polymer called SA cross-link polymeric films. A cross-link polymeric film based on sodium alginate and PVA was created using the solution casting method. When compared to pure SA, the cross link polymeric film physico-mechanical and swelling characteristics were much improved. The polymeric film containing CPF shown a substantial improvement in their bactericidal efficacy against bacteria. A drug model called ciprofloxacin was loaded into SA mix film, and the drug's release behavior from the films showed that it was H-dependent, with a high release when estimated at pH 7.2 this behavior is caused by the biopolymer's pH sensitivity. The findings indicate that this method may be a potential option for targeted and controlled medication delivery.

Keywords: Development, polymeric film, sodium alginate, tragacanth, ciprofloxacin

INTRODUCTION

In the fields of biotechnology, agriculture, gene therapy, wound healing, and controlled drug delivery, a number of polymeric films have been employed as drug carriers in recent years [1-4]. Because they are non-toxic and biocompatible, biodegradable films and hydrogels are finding use in tissue engineering and medication delivery [5].

A linear chain of (1,3)-a-D-guluronic acid and (1,4)-b-Dmannuronic acid makes up sodium alginate (SA), a naturally occurring polysaccharide [6]. The most common source of SA is marine brown algae [7]. Because of its strong mechanical strength, high hydrophilicity, biocompatibility, and biodegradability, it has been extensively utilized in pharmaceutical dosage materials and controlled drug administration [8]. SA-based microspheres were shown to be useful for drug delivery applications because of their adaptability in terms of size, shape, and capacity to ensnare both biomolecules and cells. These microspheres were suggested as a method for Netrin-1's regulated release [9].

Tragacanth is a naturally occurring gum made from the stems and branches of several trees that are found in the western and northern regions of Iran, Turkey, and India. Tragacanth gums (TG) from several species are

sold commercially as curled ribbons or flakes. However, the best grade, flakes, and ribbons often exhibit distinct physical characteristics; for example, ribbons provide lower surface activity and greater viscosity than flake forms [10][11]. TG is generally recognized as an anionic polysaccharide that is viscous, odorless, tasteless, and not carcinogenic, allergic, or mutagenic [12]. Sugar composition, methoxy concentration, and soluble and insoluble components make up TG. The origin of extraction, regional variance, growth and environmental circumstances, and seasonal changes all affect the proportions. Based on linear chains of 1,4-linked α-d-galacturonic acid residues, TG is a complex heterogeneous polysaccharide with several side chains made up of d-xylose, l-fucose, d-galactose, and trace quantities of d-glucuronic acid attached to the acidic backbone [13].

One common antibiotic used to treat many bacterial infections, including intra-abdominal infections and infections of the bones and joints, is ciprofloxacin (CPF), a fluoroquinone [14]. When tested against a variety of microorganism agents, CIP's antibacterial activity demonstrated a low minimum inhibitory concentration for both Gram-positive and Gram-negative bacteria [15]. Since large dosages typically result in substantial levels of cytotoxicity, the CIP release kinetic is crucial for tissue engineering applications. A practical and affordable mixing technique was used to generate a controlled release of ciprofloxacin for drug delivery applications, which is worth considering [16].

MATERIALS AND METHODS

Chemicals and Instruments

Sodium alginate (SA), and tragacanth were purchased from the local chemical shop, Kanpur. Ciprofloxacin was purchased as Ciplox tablets from the Cipla Pvt Ltd. All chemicals were of analytical grade.

Methods

Preparation of pure and drug loaded polymeric films

A 5% (w/v) sodium alginate was dissolved in distilled water under continuous stirring for 48 hrs, then adequate amount of tragacanth was added. The solution was poured onto a Teflon plate after air bubbles had been removed. The polymeric films were dried at room temperature to a constant weight. Preparation of corresponding drug loaded pure SA polymeric films was similarly performed. In addition, Ciprofloxacin (CPF) powder of 10% was added to the polymer solutions. The solutions were thoroughly stirred and left overnight to get rid of air bubbles before being cast on to clean Teflon plates in a dust free atmosphere at room temperature. Then the films were washed with the distilled water, placed on a Teflon plate and dried at room temperature until reaching a constant weight. The thickness of the polymeric films was kept constant by the same weight solution was poured onto the same size Teflon plate between 30±5μm [17].

Evaluation methods

Field Emission Scanning Electron Microscopy (FE-SEM) Analysis

The surface morphology samples (before and after coating with TiO2 was examined via Field emission scanning electron microscopy (TESCANMIRA3) after coating the samples with gold film using acceleration volt age of 15.0 kV [18].

Swelling index

The swelling behaviour of scaffolds was investigated at room temperature by exposing them to phosphate buffer solution (PBS). A known weight of scaffold material was placed in PBS solution for 30 days.20 The wet weight of the scaffold was determined by first blotting the scaffold surface with filter paper, to remove excess surface water and then weighed immediately [19].

$$Wsw = Ww-Wd/Wd \times 100\%$$

Where Ww represent the wet weight of scaffolds immersed in the PBS particular time interval, Wd is the dry wet of scaffolds,

Wsw is the degree of swelling.

Liquid Displacement

Polymeric scaffold samples were submersed in ethanol for 1 hr. The volume of a scaffold immersed in the liquid is equal to the volume of the displaced liquid, and we can calculate the porosity from the following equation [20].

$$P\% = W1-W3 \,/W2-W3 \times 100\%$$

Where W1: weight of the scaffold before immersion,

W2: weight of the scaffold after immersion

W3: weight after drying by this method we can just get the porosity percentage (P%).

Tensile strength

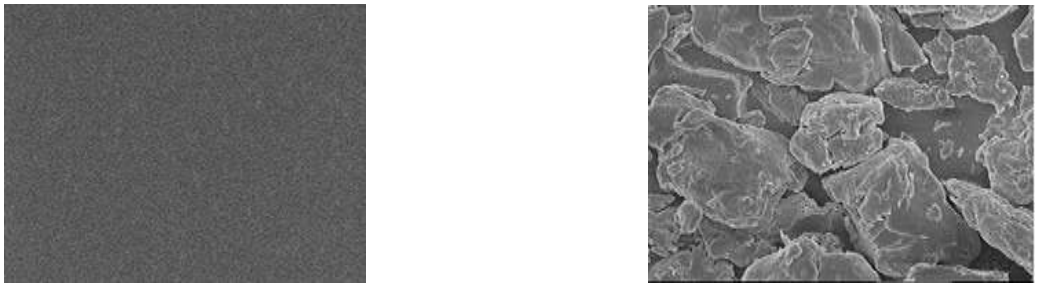
Tensile property of individual scaffolds was conducted using a (MTS Criterion 5 KN) in accordance with standard instruments, methods (ASTM D638-2010) [21]. To employ a controlled force deformation of polymeric scaffolds at room temperature (25℃). Prepared scaffold was glued onto a 10 mm gauge length paper tab and equilibrated at the specified temperature for 10 min before ramping the force at a rate of 0.01 mm min−1 until the break. A minimum of six repeat tests was conducted for each sample.

In-vitro drug release

The drug release of the polymeric films of SA-Ciprofloxacin was evaluated using the paddle over disc method. An adhesive was used to fix dry films with a given thickness over a glass plate after they have been cut into a specific shape and weighed. After the apparatus was equilibrated to 32±0.5°C, the glass plate was submerged in 500ml of the phosphate buffer (pH 7.4) or dissolving medium. Next, the paddle was moved at a pace of 50 revolutions per minute and positioned 2.5 cm apart from the glass plate. Samples (5ml) was taken out at predetermined intervals for up to 24 hours, and high-performance liquid chromatography or a UV spectrophotometer used for analysis. The mean values were computed, and the experiment performed in triplicate [22].

RESULTS AND DISCUSSION

Field Emission Scanning Electron Microscopy (FE-SEM) Analysis



a) Pure Sod. alginate (SA) b) SA-Ciprofloxacin

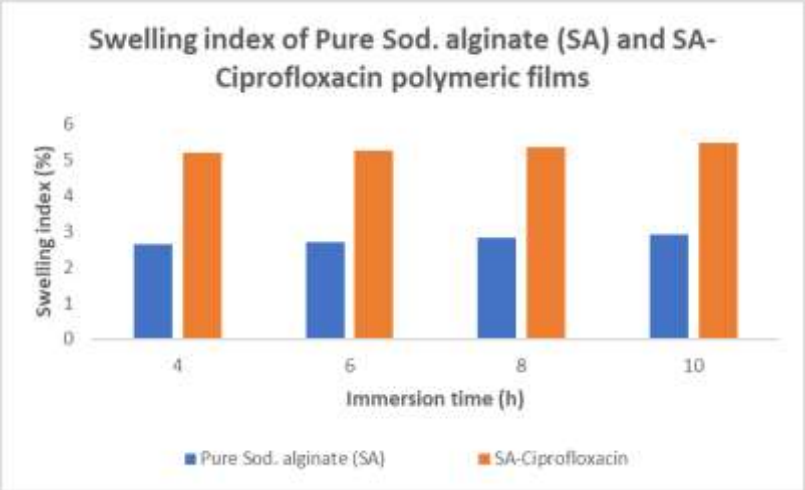
Fig 1. Field Emission Scanning Electron Microscopy (FE-SEM)

Swelling index

Table 1. Swelling index of Pure Sod. alginate (SA) and SA-Ciprofloxacin polymeric film

Immersion time (h)	Swelling index (%)	
	Pure Sod. alginate (SA)	SA-Ciprofloxacin
2	0.0	5.14
4	2.64	5.19
6	2.72	5.27

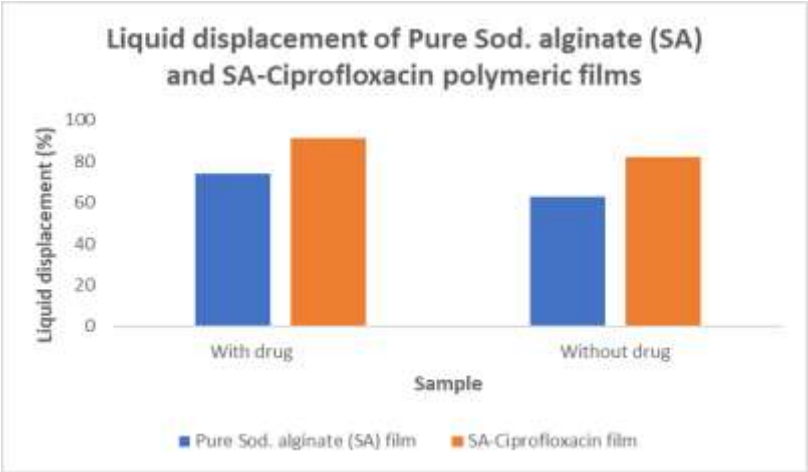
8	2.83	5.36
10	2.91	5.48



Liquid displacement

Table 2. Liquid displacement of Pure Sod. alginate (SA) and SA-Ciprofloxacin polymeric films

Sample	Liquid displacement (%)	
	With drug	Without drug
Pure Sod. alginate (SA) film	74.21	63
SA-Ciprofloxacin film	91.14	82

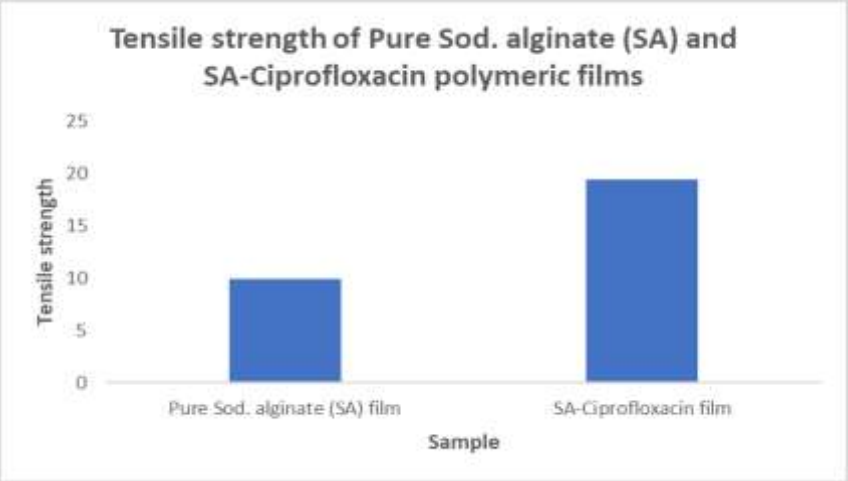


Tensile strength

Table 3. Tensile strength of Pure Sod. alginate (SA) and SA-Ciprofloxacin polymeric film

Sample	Tensile strength

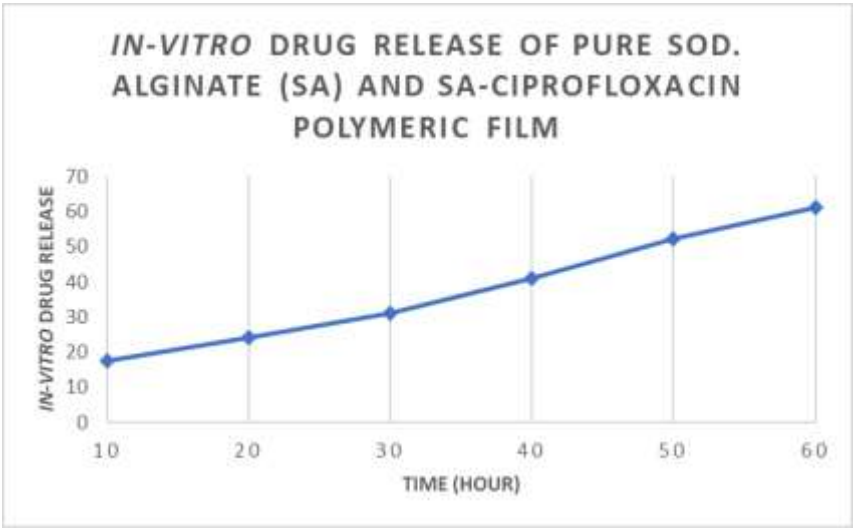
Pure Sod. alginate (SA) film	10.0
SA-Ciprofloxacin film	19.5



In-vitro drug release

Table 4. *In-vitro* drug release of Pure Sod. alginate (SA) and SA-Ciprofloxacin polymeric film

Time (hr)	*In-vitro* drug release
10	17.45±0.1
20	24.31±0.3
30	31.26±0.4
40	41.11±0.6
50	52.19±0.2
60	61.24±0.2



CONCLUSION

For the treatment of chronic disorders, the present research offered innovative polymeric films; regulated drug delivery systems may be the best option. Soluble ciprofloxacin was added to a pharmaceutical polymer called SA cross-link polymeric films. A cross-link polymeric film based on sodium alginate and PVA was created using the solution casting method. When compared to pure SA, the cross link polymeric film physico-mechanical and swelling characteristics were much improved. The polymeric film containing CPF shown a substantial improvement in their bactericidal efficacy against bacteria. A drug model called ciprofloxacin was loaded into SA mix film, and the drug's release behavior from the films showed that it was H-dependent, with a high release when estimated at pH 7.2 this behavior is caused by the biopolymer's pH sensitivity. The findings indicate that this method may be a potential option for targeted and controlled medication delivery.

CONFLICT OF INTEREST

Authors declare for none conflict of interest.

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