

Gelatin–PEG based metronidazole-loaded vaginal delivery systems: preparation, characterization and in vitro antimicrobial efficiency

S. M. Khade · B. Behera · S. S. Sagiri ·
V. K. Singh · A. Thirugnanam · K. Pal ·
S. S. Ray · D. K. Pradhan · M. K. Bhattacharya

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Abstract Bacterial vaginosis (BV) is a condition often associated with the overgrowth of pathogenic microbes with a subsequent decrease in lactic acid producing bacteria in vagina. BV is predominant in reproductive women. It has been reported not only to cause pre-term labor but is also one of the major causes of fetal morbidity and mortality. There is an increase in the vaginal discharge in BV. Due to this reason, the locally applied drug formulations are quickly washed off. It is expected that the mucoadhesive delivery vehicles will improve the bioavailability of the drug for prolonged periods. Keeping this in mind, gelatin/PEG based composite hydrogels were developed and characterized as vaginal delivery systems for the treatment of BV. The hydrogels were prepared by varying the concentration of gelatin and PEG. The hydrogels were thoroughly

characterized using SEM, FTIR, DSC, and impedance spectroscopy techniques and swelling, mucoadhesive, and texture analysis studies. The in vitro release behavior of metronidazole from the hydrogels was analyzed in-depth. The antimicrobial efficiency of the MZ-loaded hydrogels was tested against *E. coli*, occurrence of which is predominant in BV. The properties of the hydrogels were found to be dependent on the composition of the hydrogels. The hydrogels were found to be mucoadhesive and the MZ-loaded hydrogels have shown effective antimicrobial activity against *E. coli*. Based on the preliminary studies, the composite hydrogels were found to be suitable for controlled drug delivery for vaginal applications.

Keywords Bacterial vaginosis · Hydrogel · Cross-linking · Mucoadhesive · Vaginal delivery system

S. M. Khade and B. Behera contributed equally.

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S. M. Khade · B. Behera · S. S. Sagiri ·
V. K. Singh · A. Thirugnanam · K. Pal (✉) · S. S. Ray
Department of Biotechnology and Medical Engineering,
National Institute of Technology, Rourkela 769008,
Odisha, India
e-mail: pal.kunal@yahoo.com

V. K. Singh
e-mail: vinay.pharma@gmail.com

D. K. Pradhan
Department of Physics, National Institute of Technology,
Rourkela 769008, Odisha, India

M. K. Bhattacharya
Department of Botany and Biotechnology, Karimganj College,
Karimganj, Assam, India

Introduction

As a canal that connects the lower part of uterus to the outside of the body of females, vagina is populated with diverse microflora. The majority of the microorganisms, present in the vaginal lumen, are of the genus lactobacillus. There is a drastic decrease in the normal microflora due to polymicrobial infection. This condition is often associated with an increased vaginal discharge and is regarded as bacterial vaginosis (BV) [1].

BV may be effectively treated with the oral administration of antimicrobial drugs (e.g., clindamycin and metronidazole) [2]. Since metronidazole (MZ) is cheaper than clindamycin, its use has been more predominant in developing countries. The treatment regimen with MZ provides short-term cure rates as compared to the conventional therapies [3]. But the major side effects of the oral