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Fabrication and characterization of electrospun κ-carrageenan based oral dispersible film with vitamin C

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ABSTRACT

Oral dispersible films (ODF) are great alternatives to tablet medications as they will simply dissolve in the mouth. There are several ways to produce ODFs, but electrospinning is emerging as one of the best methods as it increases the surface to volume ratio which allows it to dissolve easily. ODFs are typically formulated using a combination of polymers to produce the necessary film qualities. The use of κ-carrageenan (κ-CAR), a natural polymer in ODFs are yet to be studied in detail. Therefore, this study aims to develop an ODF from a combination of κ-CAR, polyvinyl alcohol (PVA) and vitamin C, where the latter will act as a model drug carrier. 1.5w/v% κ-CAR and 14w/v% PVA at a ratio of 30:70 was added with different concentrations of vitamin C from 2 to 10w/v%, respectively. The resulting nanofibers were then examined for morphology, water contact angle (WCA) and disintegration time. All the solutions formed uniform nanofibers with an average diameter ranging from 190 to 490 nm and showed hydrophilic properties. Sample 4 showed the fastest disintegration time of 3.68 s and the lowest WCA of 38.5°. The results indicated that the best formulation for an ODF was with 8% vitamin C. The findings from this study provide promising groundwork for the use of κ-CAR as the biopolymer in combination with the PVA to develop a biopolymer-based ODF with vitamin C via electrospinning.

1. Introduction

The most common, non-invasive method for taking medicine is by oral intake and usually involves medication in the form of tablets or pills. This usually poses a problem to older and younger patients who have trouble swallowing medicine. Oral dispersible films (ODF) have emerged as one of an easy and convenient alternative as it can simply dissolve in the mouth upon contact with saliva without the need of water. In fact, ODFs have shown to increase patient's compliance for medication intake. The ODF is defined as a thin film dose form that can carry active pharmaceutical ingredients (API), nutrients or vitamins and ingredients for food supplements, where the drug loaded is rapidly released, resulting in a fine suspension or solution in the saliva [1].

ODFs require the presence of a polymer that makes up approximately half of the whole dry film to ensure rapid disintegration of the film to deliver the drug or nutrient [2]. To produce the necessary film qualities, the polymers can be used alone or in combination with other polymers. Non-toxic, non-irritant polymers are essential, as well as the absence of leachable contaminants. Typically, water-soluble polymers from both natural and synthetic sources are used to create a thin film with rapid disintegration, high mechanical strength, and a pleasant mouth feel [3].

Polyvinyl alcohol (PVA) is one of the most widely used synthetic polymers in the biomedical field. It offers good mechanical qualities, a high ability to produce films, nontoxicity, water-solubility, no carcinogenicity, hydrophilicity, good compatibility, and biodegradability in human tissues and fluids [4]. On the other hand, κ-carrageenan (κ-CAR) is a natural biopolymer which is derived from red seaweed. It is abundantly available and has substantial valuable properties, which have made it a recognized biomaterial used in food packaging, wound healing as well as in the pharmaceutical industry. Another important feature of using κ-CAR as a component in the ODF is it has fast disintegration rates which allow efficient release of the drug or nutrient [5]. Besides that, many studies have focused on combining κ-CAR with other polymers to take advantage of κ-CAR's gelling capabilities and

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