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Commentary

SIMULTANEOUS PROCESS TO PRODUCE FOLIC ACID-CONTAINING NANOFIBERS FOR TRANSDERMAL MEDICATION DELIVERY

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INTRODUCTION

The largest organ in the body, the human skin, has an important functional role in shielding the body from pollutants, UV radiation, and other factors that contribute to skin ageing and disorders. The morphological structure of skin is well-organized, and it possesses a self-renewing barrier property. It is a protective barrier made up of three layered structures with distinct levels of cellular and epidermal development. The epidermis, also known as the Stratum Corneum (SC), is the outermost layer of the skin and comprises dead cells (corneocytes) scattered inside a greasy matrix. As a result, SC provides selective permeability, limiting the penetration of hydrophilic-rich substances into the inner layers. Passive diffusion, which is related to Fick's Law, is the primary mode of transport for many bioactive compounds in the skin.

Nanofibers containing bioactive agents are highly specific and suitable for skin care applications. Bioactivity on a hydrophilic basis nanofibers were manufactured by a simultaneous process of electrospinning and electrospray. Polyvinyl Polymers of Alcohol (PVA), Polyvinyl Alcohol Gelatin (PVAGel), and Polyvinyl Alcohol Alginate (PVAAlg) were used as the matrix material; while at the same time Folic Acid (FA) particles were dispersed on the surface of these hydrophilic nanofibers. The morphology of the Nano-Fibers (NF) was uniform, and the dispersed folic acid particles were incorporated into the nanofiber structure, as confirmed by a Scanning Electron Microscope (SEM). The thermal behavior and chemical structure of the assembled nanofibers have been analyzed / studied by Thermogravimetric Analysis (TGA) and Attenuated Total Reflection Fourier Transform Infrared (ATRFTIR) spectroscopy, with no chemical bonds between vitamins and polymers. Controlled release of FA-loaded electrospinning fibers was performed by UVV is in vitro studies within 8 hours in an artificial sweat solution (acidic medium, pH 5.44). Furthermore, it has been suggested that nanofibers containing folic acid as a patch can prevent COVID19. The results of the cytotoxicity assay on L929 cells show that all NFs produced have little or no cytotoxicity. PVA and PVAGel with and without FA nanofibers appear to be more biocompatible than PVAAlg nanofibers.

Nanofibers have played an important role in various fields of biomedical research, from drug delivery to wound healing and cell regeneration, because they have a large specific surface area and their properties can be adjusted by changing the composition and manufacturing conditions. The use of hydrophilic polymers in the production of electrospinned nanofibers has proven beneficial in the development of fast dissolution delivery systems with reduced drug-drug interactions. In general, a mixed combination of natural and synthetic polymers is preferred. Synthetic polymers can provide adequate mechanical strength while improving electrospinability. Natural macromolecules promote cell adhesion and can better mimic the ECM environment. In addition, the increased hydrophilicity provided by natural macromolecules is beneficial when carrying hydrophilic drugs. Nanofiber scaffolds made of natural and synthetic polymers have been shown to be suitable for developing drug delivery systems in combination with mixed polymer electrospinning or bioactive drugs. Previously, electrospinned nanofibers were made from a single polymer source, but more recently, polymer combinations have been created to develop so-called polyblended nanofibers. Polyblended nanofibers are a new type of biomaterial that can act as mimics of natural tissue while presenting topographical and biochemical stimuli that support healing. Scaffolds are made from a variety of polymers, including poly vinyl alcohol, poly ethyl oxide, poly(lactic acid), poly(glycolic acid), poly (lacticcoglycolic acid),

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poly (caprolactone), and natural Extra Cellular Matrix (ECM) analogs, such as collagen, gelatin, silk, chitin, chitosan, alginate, and hyaluronic acid, because of their lack of toxicity, superior biocompatibility, cell adhesion, and proliferation capability. In this regard, PVA-based hydrophilic materials can be blended with natural polymers and used in drug delivery systems.

Bioactive compounds can partially lose their therapeutic effect during the blended electrospinning process. It is important to have a means of protection. Certain procedures must be followed to ensure that the drug maintains biological activity. In this regard, electrospray can be used for drug delivery applications, especially for encapsulation of bioactive compounds. Electrospray, also known as Electro Hydrodynamic spray (EHDA), is commonly referred to as a unique and simple technology that can electrostatically control the formation of droplets. Folic Acid (FA) is defined as a multifunctional ingredient that is safe to use and can even be combined with other chemicals. In addition, folic acid has received a lot of attention from researchers in the fields of biomedicine, biotechnology, and regenerative therapy because of its non-immunogenicity, high stability, and ability to support tissue regeneration. In this regard, there is increasing research on the use of folic acid in a wide range of applications in the form of micro/nanocapsules, liposomes, hydrogels or nanofibers. However, there is no literature study on the use of nanofibers containing FA in tissue engineering applications formed by both mixed electrospinning and concurrent processes.

CONCLUSION

The main purpose of this study is to produce various PVA-based nanofibers, including FA, by two different processes, electrospinning and co-spinning, and to evaluate their controlled release and cell proliferation properties. The properties of PVA-based NFs in terms of morphology, thermal stability, and chemical structure have been analyzed by altering the properties of the polymer matrix.