International Research Journal of Pharmacy and Pharmacology Vol. 11(1) pp. 1-3, February, 2023
Available online https://www.interesjournals.org/pharmacy-pharmacology.html

Expert Review

The Cooling Mechanical Press Method was used to Create Nanoparticles from Essential to Healthy Blends

Brick Mansion*

Fibre and Polymer Technology, School of Chemical Science and Engineering, KTH–Royal Institute of Technology, SE-100-44 Stockholm, Sweden

*Corresponding Author's E-mail: Brickmansion@gmail.com

Received: 07-Feb-2023, Manuscript No. Irjpp-23-88947; **Editor assigned:** 09-Feb-2023, PreQC No. Irjpp-23-88947 (PQ); **Reviewed:** 23-Feb-2023, QC No. Irjpp-23-88947; **Revised:** 27-Feb-2023, Manuscript No Irjpp-23-88947(R); **Published:** 01-Mar-2023, DOI: 10.14303/2251-0176.2023.64

Abstract

When applying mechanical press micro fabrication to the production of micro needles, fish scale biopolymer blended with nanocellulose crystals is used. The effect of nanocellulose on micro fabrication, water absorption, moisture stability, and the mechanical properties of the micro needles is reported. The findings demonstrate that, in comparison to micro needles made solely from fish scale biopolymer, which were mouldable at 20.5 °C, micro needles made from the nanocellulose-loaded fish scale biopolymer require a micro melding temperature of 60.5 °C. Compared to fish scale biopolymer (FSBP) films, the addition of nanocellulose (NC) led to lower elongation and higher tensile stress in the fish scale biopolymer-Nano cellulose (FSBP-NC) films' mechanical properties. The FSBP films dissolved completely within one minute, indicating that the FSBP-NC films can be used to produce micro needles with a prolonged dissolution rate, while the nanocellulose also prevented the needles from dissolving and absorbed up to 300 percent and 234 percent of its own weight in water (8 percent and 12 percent w/w NC/FSBP, respectively). The NC gels and the FSBP-NC films were contrasted using FTIR spectrometry. The FTIR revealed interactions and typical peaks for fish scale polymer and nanocellulose. At NC contents of 8% and 12% w/w NC/FSBP, respectively, SEM micrographs revealed relatively good dispersion of NC in FSBP.

Keywords: Micro needles, Nanoparticles, Cellulose, Fish scales, Biopolymer, Drug delivery, Biomaterials, Micromolding

INTRODUCTION

Materials for micro needle patches that are used in biomedical applications like transdermal drug delivery and vaccine delivery must not only be biocompatible and biodegradable, but they also need to be processed using reproducible micro fabrication methods and strong enough to pierce the skin (Ying JZ et al., 1987). It has been demonstrated that structures with sharp tips can be successfully formed, pierced, and dissolved into the skin in less than one minute using biopolymers extracted from fish scales for the production of micro needles. The centrifugation method is the most common one for making dissolvable polymer micro needles. To ensure that the polymer completely fills and consolidates within the template cavities, the centrifuge method requires up to 15 minutes of centrifugation and several hours of drying at room temperature. A mechanical press could be used for the micromolding as an alternative method. In the past, the production of micro needles from polycarbonate by means of a mechanical press required heating the material to close to 180°C in order to produce out-of-plane micro needles with sharp tips in a short amount of time. It would have the advantage of requiring shorter times for micro fabrication, which has not yet been demonstrated for biopolymer micro needles (Sullivan R et al., 2006) (Barros et al., 2007).

METHODS

The well-known property of biopolymers like gelatine, collagen, and starch of their tendency to absorb water, which also affects their stability after processing, is a major obstacle in the context of making biodegradable polymeric micro needles. Although water absorption poses a challenge to the stability of biodegradable polymers, little research has been done to use natural filler reinforcements like cellulose to improve the stability of biodegradable polymer-based micro needles. Due to their mechanical strength in high toughness membranes, cellulose nanoparticles have been used in biomedical applications like drug delivery and scaffolds. They also possess biocompatible properties. In hydrophobic engineering polymers, the tendency of cellulose to absorb water is undesirable because it weakens the fibre and composite. Attempts to deal with this include: reducing the amount of cellulose in the composite to the bare minimum required to increase its mechanical strength, strengthening the bond between the fiber and the matrix by using a compatibilizer, or altering the cellulose fibers to make them more hydrophobic. Hydrophilic polymers, on the other hand, are known to perform better because of their improved miscibility with cellulose. When compared to the unmodified starch polymer, for instance, the water sensitivity of the starch composite was lessened by ramie cellulose (Gregori et al., 2007) (Patrick DM et al., 2004)

Reproducible biodegradable micro needles made from fish scale biopolymer reinforced with nanocellulose (FSBP-NC) are produced using mechanical press micro fabrication in this study (Tang YZ et al., 2007). In addition to the possibility of preparing arrays of micro needles from FSBP-based materials, we examine the possibility of applying this method at a much lower temperature, which necessitates less time spent waiting. To this end, the fabrication, mechanical strength, and moisture stability of fish scale micro needles are all examined in this study in relation to nanocellulose (NC). It is demonstrated that the use of nanocellulose makes it possible to produce needles that are stronger, stiffer, and more resistant to moisture.

DISCUSSION

NC 30's weight increased to 0.4 g and NC 20's weight increased to 0.334 g, the FSBP-NC films had greater capacity for water absorption. In order for the FSBP-NC films to completely degrade in water, it was necessary to leave them overnight. Even after 30 minutes in water, the FSBP-NC films remained strong enough to hold a spatula without breaking. The films began to break down (albeit slowly) after about 35 minutes, causing the weight to drop. It was determined that this was the upper limit for water absorption. The FSBP films completely dissolved in water in less than 5 minutes, whereas the FSBP-NC films took 12 hours to completely degrade in water. Despite the appearance of tree-like protruding structures in the SEM, it is clear from this result that the cellulose nanoparticles were sufficiently dispersed within the fish scale biopolymer to have a significant impact on water absorption and its capacity to retain some mechanical properties as a dispersed network of cellulose nanofibres.

A desirable property, this NC-related water absorption capacity could be used to create microneedles with controlled water absorption properties. Our subsequent research will investigate this further.

All of the films used to make microneedles were used right after they were dried, so their moisture content remained between 16% and 18%. According to previous research, the actual glass transition temperature of biopolymers like fish gelatin, wheat gluten, heparin, proteins, and polyamides is influenced by the amount of moisture present, and conventional methods make it difficult to measure it. Fish gelatin's measured glass transition temperature ranged from 40 to 190 °C. As a result, we anticipate that an increase in moisture content will facilitate the mechanical heat press formation of microneedles. However, due to the increased moisture content and consequently weaker structure, this may present additional challenges, such as microneedle breakage or bending upon removal from mold. When the microneedles were taken out of this study, they were already dry.

The low temperature press method yielded the single and array microneedles depicted from FSBP-NC and FSBP films. At temperatures ranging from 50 to 90°C, microneedles in both single and array form were formed. While FSBP-NC only partially formed needles, both array and single microneedles were successfully formed at 70 °C. The FSBP microneedle's tippets were significantly sharper than those of the FSBP-NC, as depicted. To get a complete array of FSBP-NC films for the NC20, the temperature had to be raised to 90 °C. This was probably because, as depicted in the FSBP films had greater elasticity at 70 °C than the FSBP films did (Heberer T et al., 2002).

For NC 30, microneedles did not form at the applied pressure. This was probably because the polymer's plasticity had already decreased to the point where it was no longer suitable for micromolding. Perhaps micromolding for NC 30 would occur if the pressure was raised; however, pressure was not varied in this study due to the limitations of our equipment (Li WC et al., 2014).

CONCLUSION

For the production of biopolymer microneedles, the use of FSBP-NC films produced microneedles with sufficient strength to penetrate the skin. Particularly the 20 g NC-containing films had sufficient flexibility and thermal properties for micromolding. Using a mechanical press at relatively low temperatures, this study demonstrates that biodegradable polymers of FSBP and NC blends can be used to produce consistent arrays of microneedles. The dispersion of the NC in the FSBP is sufficient to affect the mechanical and moisture properties, as demonstrated by the discussed results, despite the presence of some aggregation in the

SEM imaging. Films containing 20 and 30 g NC FSBP have a significantly higher capacity for water absorption and moisture stability. FSBP-NC microneedles are strong enough to penetrate the skin and degrade at varying rates thanks to the combination of these properties.

ACKNOWLEDGEMENT

None

CONFLICT OF INTEREST

None

REFERENCES

1. Ying JZ, Mao XL, Ma QM (1987). Icons of Medicinal Fungi from China. Science Press. 43(4): 12-19.
2. Sullivan R, Smith JE, Rowan NJ (2006). Medicinal Mushrooms and Cancer Therapy: Translating a traditional practice into Western medicine. Perspect Biol Med. 49(4):159–170.
3. Barros L, Baptista P, Correia DM (2007). Effects of conservation treatment and cooking on the chemical composition and antioxidant activity of Portuguese wild edible mushrooms. J Agric Food Chem. 55(4): 4781–4788.
4. Gregori A, Svagelj M, Pohleven J (2007). Cultivation Techniques and Medicinal Properties of Pleurotus spp. Food Technol Biotech. 45(2): 238–249.
5. Tang YZ, Zhu LW, Li HM (2007). Submerged culture of mushrooms in bioreactorschallenges, current-state-of-the-art, and future. Food Technol Biotec. 45(2): 221–229.
6. Patrick DM, Marra F, Hutchinson J (2004). Per capita antibiotic consumption: How does a North American jurisdiction compare with Europe? Clin Infect Dis. 39(4): 11-17.
7. Li WC (2014). Occurrence, sources, and fate of pharmaceuticals in aquatic environment and soil. Environ Pollute. 187(6): 193-201.
8. Heberer T (2002). Occurrence, fate, and removal of pharmaceutical residues in the aquatic environment:A review of recent research data. Toxicol Lett. 131(4): 5-17.
9. Banci L, Ciofi-Baffoni S, Tien M Lignin (1999). Peroxidase-catalyzed oxidation of phenolic lignin oligomers. Biochemistry. 38(5): 3205-3210.
10. Deblonde T, Cossu-Leguille C, Hartemann P (2011). Emerging pollutants in wastewater: A review of the literature. Int J Hyg Environ Heal. 214(4): 442-448.