**Effect of Various Urea Concentrations on Nitrogen Slow Release from PLLA Nanofiber Mat**

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**Introduction**

Electrospinning technique has attracted interest as a versatile and inexpensive technique to manufacture micro- and nanofibers from polymer solutions [1]. High surface area and ease of incorporation of active ingredients have prompted some researchers to investigate using electrospun nanofibers in agricultural application [2]. Urea is a cost-effective fertilizer used to promote plant growth and increase crop production. However, uncontrolled use of urea fertilizer is harmful to plants and can lead to soil and water pollution [2]. Therefore, many researches have been made efforts to increase the efficiency of urea fertilizers use by prolonged-released systems such as nanofibers.

**Aims**

This study aimed to investigate the effect of different urea concentrations on nitrogen slow release rate from electrospun Poly (L-lactide) (PLLA) nanofibers.

**Methods**

PLLA with a molecular weight of 282kD was purchased from Vorina Company in Ireland. Solvents, Chloroform (CF); and Acetone (Ace) were obtained from Australia Sigma Aldrich. Urea was provided from Richgro Products. PLLA solution with optimum concentrations of 5% (w/w) in CF: Ace (3:1 v/v) was prepared and mixed with 10, 20, and 40% (w/w) urea. The prepared solutions were fed to a horizontal electrospinning setup. The electrospinning process was carried out at a voltage of 12kV and a flow rate of 1 mL/h. The distance of the syringe tip and aluminum foil was 15 cm. PLLA nanofiber mats loading urea were cut into 2 cm × 6 cm pieces and placed into 20 mL of milli-Q water. TNM-1 total nitrogen instrument (Shimadzu) was used to measure nitrogen release from the nanofiber mats.

**Results and Discussion**

By keeping all electrospinning parameters constant and increasing the urea concentration from 0 to 40% into PLLA solution, the diameter of PLLA electrospun nanofibers increased from 496.183nm to 782.231nm (Table 1). Increasing urea percentage from 10% to 40% let to initial nitrogen release at a higher rate. The results in Figure 2 showed the nitrogen release rate of PLLA nanofibers was not significantly affected by various urea concentrations (P value =0.361). Results revealed after 39 hours, the accumulative nitrogen release for PLLA nanofibers loading 10%, 20%, and 40% urea concentration had achieved over 80% release and nitrogen release prolonged up to 3000 hours for all samples.

**Table 1.** Effect of urea concentration on electrospun nanofiber diameter.

|  |  |  |
| --- | --- | --- |
| Urea Concentration (\*% w/w) | Nanofibre diameter (nm) | \*\*CV% |
| 0 | 496.183 | 22% |
| 10 | 650.154 | 33% |
| 20 | 710.000 | 37% |
| 40 | 782.231 | 31% |

**Figure 1.** Cumulative nitrogen release from nanofibers

**Conclusion**

Increasing urea percentage loaded into nanofibers from 10% to 40% led to larger nanofiber diameters and increased initial rate of nitrogen release. Furthermore, nanofiber samples released nitrogen for three months, although high urea concentration did not affect the nitrogen release rate significantly.

**References**

1. Subbiah, T. et al. (2005). Electrospinning of Nanofibers. J. App. Poly. Sci., 96, pp. 557–569.
2. Noruzi, M. (2016). Electrospun nanofibers in agriculture and food industry: A review. J. Science of Food and Agriculture., 96. 4663–4678.