

Soaking as a method for incorporation of ibuprofen into PVA filament for 3D printing

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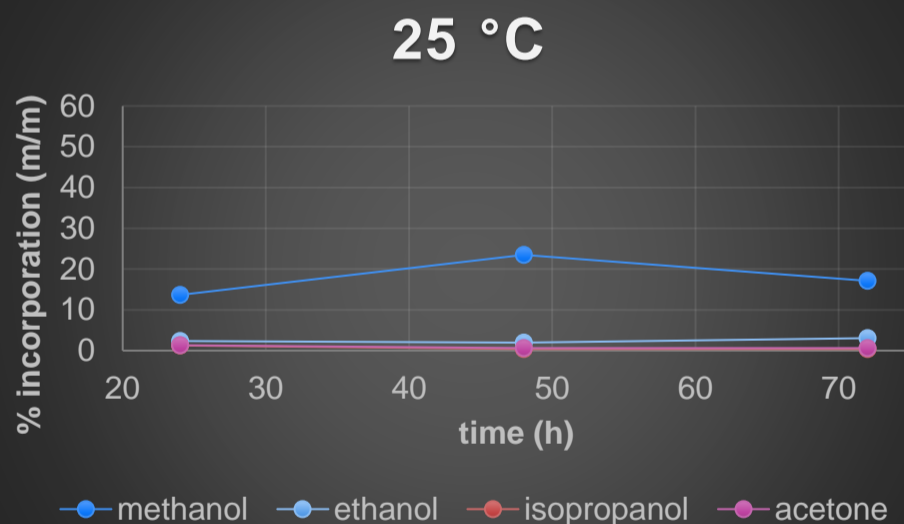
One of the newer technologies for the development of pharmaceutical formulations that is attracting increasing interest is 3D printing. Fused deposition modeling (FDM) is a 3D printing technology often used in pharmaceutical field. The soaking method allows the incorporation of active pharmaceutical ingredient into commercially available filaments for FDM 3D printing. The aim of this study was to investigate the influence of an organic solvent on the incorporation of ibuprofen into polyvinyl alcohol (PVA) filament by soaking.

The solubility of ibuprofen in methanol, ethanol, acetone and isopropanol was determined at 25°C and 40°C, in order to obtain saturated solutions. Incorporation of ibuprofen into commercial PVA filament was done by soaking filaments in saturated solutions of ibuprofen in the abovementioned solvents. Incorporation was performed at 25°C and 40°C. The measurement of the proportion of ibuprofen in PVA filaments was performed after 24h, 48h and 72h of incubation. The filaments were dissolved in phosphate buffer pH=6.8 and the concentrations of ibuprofen were determined by UV/Vis spectrophotometric method. Based on the obtained data, the proportion of ibuprofen in the examined filaments was calculated.

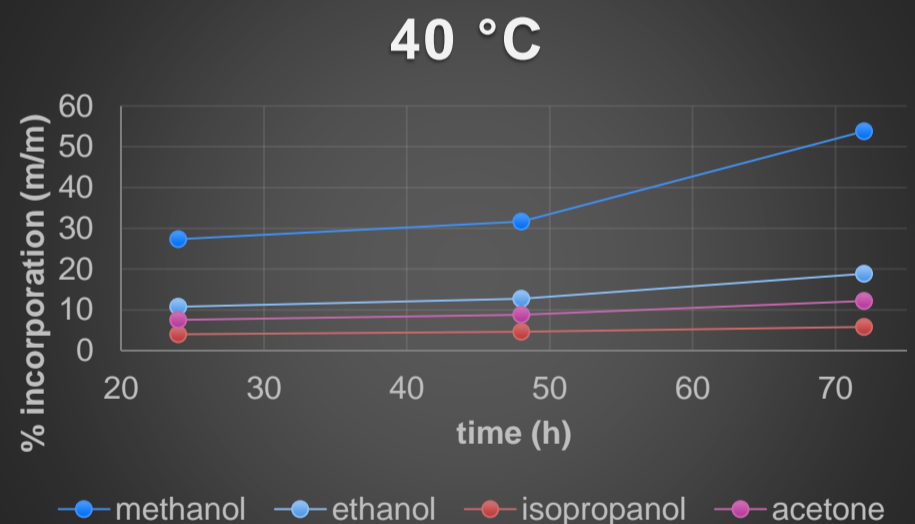
RESULTS



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Graph 1. Dependence of ibuprofen content in soaked filaments on the duration of filament soaking in saturated ibuprofen solution at room temperature (25°C)



Graph 2. Dependence of ibuprofen content in soaked filaments on the duration of filament soaking in saturated ibuprofen solution at 40°C

The highest solubility of ibuprofen was observed in acetone (21.67 ± 1.38 mg/ml at 25°C and 27.35 ± 7.92 mg/ml at 40°C). The effect of elevated temperature on the increase in the proportion of ibuprofen in PVA filaments is observed for all investigated solvents. The influence of the length of incubation on the increase of incorporation of ibuprofen into the PVA filament was observed in all solutions at 40°C, while at 25°C a longer incubation can lead to a decrease in the proportion of ibuprofen in the filaments. The best incorporation of ibuprofen into the PVA filament is observed after incubation in methanol solution, where the mean value of the proportions obtained after 72 hours of incubation at 40°C is 54.42%.

Solvent selection, incubation length, and temperature can significantly affect the efficiency of ibuprofen incorporation into PVA filaments by the soaking method. It is important to choose the best combination of the above factors, in order to obtain filaments suitable for 3D printing.

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