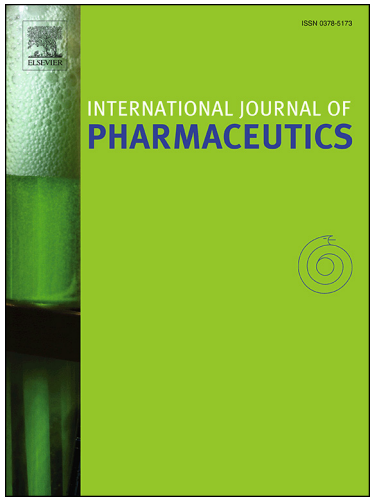

Development of customised 3D printed biodegradable projectile for administrating extended-release contraceptive to wildlife

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Development of customised 3D printed biodegradable projectile for administrating extended-release contraceptive to wildlife

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Abstract:

Customisation of sustained and controlled release of contraceptives plays a key role in veterinary applications. A biodegradable projectile containing different doses of contraceptive progesterone was prepared using fused deposition modelling 3D printing. Three concentrations of progesterone (2, 5 and 10 % w/w) with polylactic acid was prepared as a 1.75 mm filament by hot melt extrusion. Solvent dissolution tests confirmed the successful incorporation of progesterone in the polymer while microscopic (SEM) studies indicated the drug was melted and thoroughly mixed with the polymer matrix and pore-formation after dissolution. A significant suppression of melting temperature of polymer from 166 to 145℃ was noted by thermal analysis (DSC) studies of the drug loaded systems. Interaction between the contraceptive drug and the polymer via hydrogen bonding was revealed from the spectroscopic (FTIR) studies. In vitro release behaviour was assessed over a five-month period, for 2% and 5% progesterone loaded projectiles release profiles fitted zero order whereas 10% loaded projectiles fitted the Higuchi model. Penetration assessment confirmed the drug loaded PLA projectiles provided sufficient specific kinetic energy required to penetrate thin and medium-thickness skins. This work demonstrates the feasibility of fused deposition modelling 3D printing as suitable process for manufacturing ballistic customised drug delivery devices.

Keywords: Fused deposition modelling, hot melt extrusion, 3D printing, biodegradable projectile, polylactic acid, progesterone