Output 3.1

One drug releasing implant for breast replacement upon resection due to cancer

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One drug releasing implant for breast replacement upon resection due to cancer

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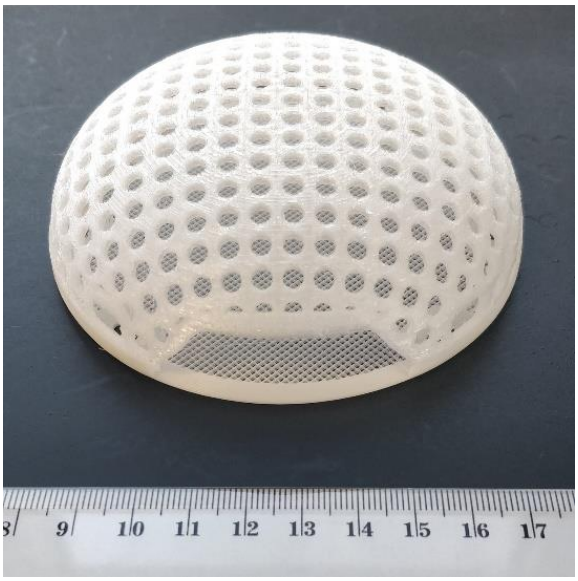
Photo of a prototype



Novel type of drug releasing, biodegradable breast implant (scale in cm).

Report detailing the composition of the system and manufacturing procedure

Materials

Dexamethasone (in the form of free-flowing powder) and biodegradable polymer (in the form of pellets) were used to prepare drug loaded, biodegradable implants for breast replacement after breast resection due to cancer.

Implant preparation

The following key steps were conducted:

- Preparation of a homogeneous mixture of polymer pellets and dexamethasone powder
- Extrusion of the mixture on a twin screw extrusion machine to obtain a filament
- Grinding of the filament to obtain drug-polymer-based pellets
- Feeding of the drug-polymer pellets into a single screw extrusion machine in order to obtain a filament with a stable diameter (1.75mm +/- 0.05mm)

Drug loaded polymeric filaments were prepared by hot melt extrusion using Thermo Scientific Process 11 apparatus.

Fig. 1: Hot melt extruder used for the preparation of dexamethasone loaded polymeric filaments: an intermediate product for the manufacturing of novel drug releasing breast implants (source: Thermofisher).

The following dexamethasone-polymer-based pellets were obtained:

Fig. 2: Pellets obtained by hot melt extrusion of dexamethasone-polymer blends used as intermediate products to manufacture the drug releasing breast implants.

These pellets were hot melt extruded to obtain the following filaments:

Fig. 3: Filaments obtained by hot melt extrusion of dexamethasone polymer based pellets. The filaments were used to feed the FDM 3D Printer used to manufacture the drug releasing breast implants.

The drug loaded polymeric filaments were used to feed a 3D printer to produce the drug loaded breast implants by FDM (fused deposition modelling) using a Raise3D pro2 apparatus.

Fig. 4: Fused deposition modelling 3D printer used to manufacture the innovative drug releasing breast implants (source: Raise3D).

Report documenting the key properties of the system

Methods

Implants were exposed to phosphate buffer pH 7.4 (USP 42) in flasks under sink conditions: 1 implant was exposed to 300 mL release medium. The flasks were placed into a horizontal shaker (GFL 3033; Gesellschaft fuer Labortechnik, Burgwedel, Germany), providing 37 °C body temperature. The flasks were shaken at 80 rpm. These are frequently applied conditions to mimic the conditions in the patient's body.

Fig. 5: Horizontal shaker used to perform the in vitro drug release measurements from the innovative drug releasing breast implants (source: GFL Labortechnik).

At predetermined time points, 1 mL samples were withdrawn from the released medium, and replaced with fresh phosphate buffer pH 7.4. The drug concentration in the withdrawn samples was determined by HPLC analysis using an Alliance e2695 apparatus (Waters Division, Milford, USA), equipped with an UV detector. Samples (50 µL) were injected into a reverse phase column C18 (Gemini 3 µm, 110 Å, 100 × 4.6 mm, Phenomenex, Le Pecq, France) (mobile phase = acetonitrile: water 33:67 V:V, flow rate = 1.2 mL/min). Dexamethasone was detected at λ = 220 nm.

Fig. 6: HPLC Alliance e2695 apparatus used to quantify the amount of drug released into the withdrawn release medium samples at different time points (source: Waters).

Figure 7 shows a picture of the basis of an implant, which was printed using the prepared drug loaded filaments and an FDM 3 printer.

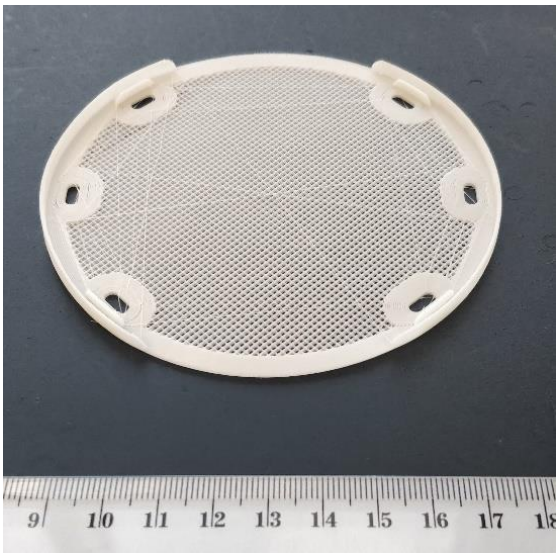


Fig. 7: Photo of the basis of an innovative breast implant, able to control the release of dexamethasone. The scale is in cm.

Figure 8 shows a picture of a complete drug releasing breast implant, consisting of a basis and a dome, both parts were printed using the prepared drug loaded filaments and an FDM 3 printer.

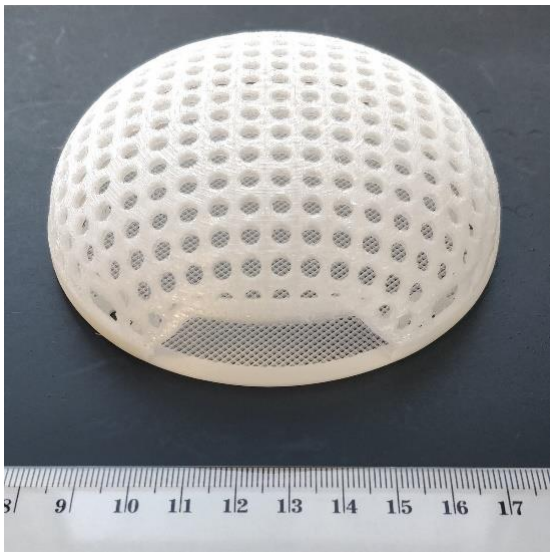


Fig. 8: Photo of the innovative breast implant, able to control the release of dexamethasone. The complete implant consists of a basis (Figure 7) and a dome. The scale is in cm.

Importantly, dexamethasone release from the biodegradable implant is well controlled over time, as shown in Figure 9.

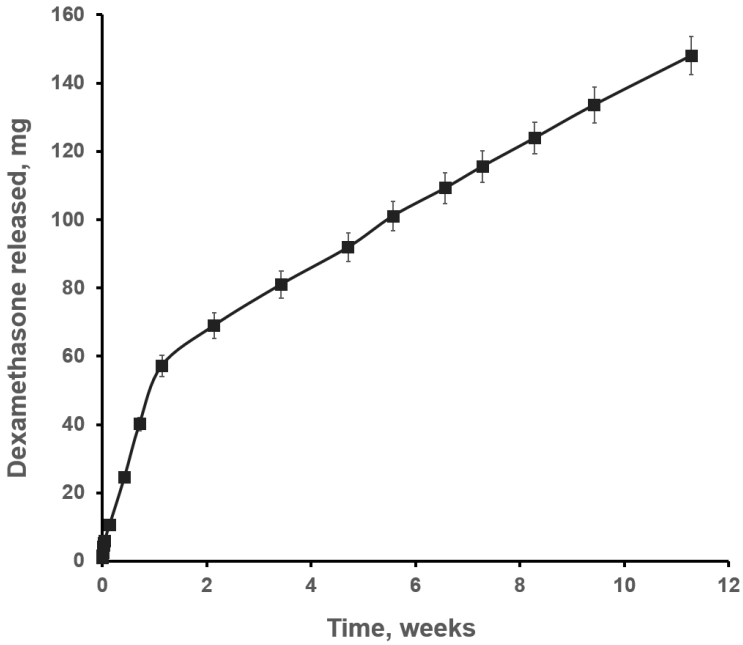


Fig. 9: Dexamethasone release kinetics from the novel breast implants upon exposure to phosphate buffer pH 7.4 (USP 42) at 37 °C and 80 rpm to mimic the conditions for drug release in vivo.