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Extended Abstract
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Nanotechnology-2019: Biocompatibility of 3D Printing Materials tested in Vivo Using Danio rerio: Zuzana Nejedlá, Jan Evangelista Purkyne University, Czech Republic.

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3D printingand 3D nanoprinting techniquesare currently very popular in the field of customized fabrication. For the wide applicatibility, cost and time-effective properties of this technology is gaining the usage in industry, biology, medicine and ingeneering. The process of printing is accompanied by several physical changes, which can influence the biological effects on organisms. In connection with usage of these technologies for various laboratory and cultivation devices, is necessary to test the toxicity and biological activity of the released nanoparticles.

Twelve different printing materials were tested in vivo using Fish Embryo Acute Toxicity Test (FET) established by OECD. Tested samples were prepared by leaching of printed blocks in a E3 medium for 72h with the assistance of a magnetic stir bar spinning at approximately 240 rpm in controlled conditionsfor releasing monomers and nanoparticles. Each material was tested on 60 embryos of two different danio lines - wildtypes and Caspers. The biological effect of embryos development were analyzed every 24 hour by binocullar magnifying glass and fluorescent mikroscope. Lethal signs as a coagulation, malformatin, lack of somite formation, heart oedema and retardation were recorded for 96 hours.

According results of toxic screening the Casper line is much more sensitive to toxic effects of observed materials. That points to differences between toxicity screening results of normal and hypersensitive individuals. Several toxic materials was obsereved and this effect was not connected to pigmentation of material as we supposed. Charachterization of all tested materials and estimation of suitability in terms of biocompatibility will be presented.

The recent hype surrounding 3D printing (3DP) attests to its growing popularity in almost every manufacturing sector including medicine, architecture, sports, aerospace and automotive engineering and contemporary arts. 3DP comprise a host of processes and technologies that offer a diverse spectrum of capabilities for the manufacturing of end-use products and devices in different materials. The digital manufacturing process simply involves feeding a virtual model (usually 'STL' file) into a designated 3D printer to build parts in successive layers until the desired 3D part is completed. Despite the potentials of 3DP offering significant benefits in terms of speed , independent biological evaluation of manufactured devices is highly recommendeddue to the unique parameters of the manufacturing process, which can influence their physical, chemical and biological properties. In this study, E-Shell 450 clear methacrylate indicated for hearing devices is examined for biological safety using zebrafish bioassays adapted to the Organization for Economic Cooperation and Development (OECD) fish embryo test

In this work we demonstrate that we can adapt the Fish Embryo Test (FET) as a new method to quantify the toxicity of 3D printed microfluidic devices. We assessed the biocompatibility of four commercially available 3D printing polymers (VisiJetCrystal EX200, Watershed 11122XC, Fototec SLA 7150 Clear and ABSplus P-430), through the observation of key developmental markers in the developing zebrafish embryos. Results show all of the photopolymers to be highly toxic to the embryos, resulting in fatality, although we do demonstrate that post-printing treatment of Fototec 7150 makes it suitable for zebrafish culture within the FET. We also performed long-term culture of the wild-type zebrafish within 3D printed wells – designed according to the 24-well plate dishes used above. These were also fabricated with and without wax support material. Control samples were melted wax support material (10 mg) at the bottom of a standard Corning 24-well plate and clean untreated Corning wells.

Discussion Experimental results in this study indicate that non-treated methacrylate is extremely toxic in zebrafish bioassay. Ethanol-treated methacrylate, on the other hand, induced a relatively lower lethality Inventions but surviving fish showed cumulative sublethal

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and teratogenic effects. The improved biological performance is likely due to induced swelling in polymeric chains, which allowed chemical compounds to diffuse in the ultrapure water

Conclusions With the current influx of 3D printers and materials [35], it is imperative that the biological performance of 3D-printed medical devices is not overlooked. Users are advised to exercise caution and if necessary demand approved certification for the materials. Since 3DP is not a “one-stop” manufacturing process, operators should take cognizance of the potential toxicity of the chemicals used and implement safety measures to limit their exposure. The limitations of the study lie in the extrapolation of the toxicological data to human responses, hence quantitative analysis of the observed compounds and their throughput in zebrafish bioassays are recommended for further study.

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