Alternative ways to cultivate and use a cell-based model in tests for toxicity

The aim of this master thesis project was to improve a testing method based on human cells cultured in a laboratory for assessing chemical toxicity. We tried to do that by reducing animal products involved and by transforming the cells that were previously used into cells that reside in the human body and are responsible for reacting to toxic substances.

Everyone wants to use safe products but also without hurting animals. A way to do that is by testing substances in laboratory-cultured human cells. But how can somebody keep human cells alive outside the body? There are specifically designed cells, called cell lines, that can be kept alive in plastic containers if we provide them with appropriate food. The problem so far is that their food contains a product derived from unborn calf blood, and this is problematic for both ethical and scientific reasons, as this serum is quite variable, and this can induce variation in experiments. We thus tried to completely remove it or at least reduce it. Then we tested if the cells could react similarly as before, and surprisingly they did if we did not remove more than 50% of the blood product. With some more work this means that cells can possibly go vegan, too!

The other testing that we did was by transforming our cells, or as we say differentiate. Imagine how from a single cell whole babies are formed, head, hands, torso but also lungs, heart, skin. There is an internal system that makes our cells specialize into different functions and that is what we tried to do. We tried to differentiate a cell line into specialized cells that are involved in recognizing toxic substances in our body, so-called dendritic cells. Then we wanted to see if these differentiated cells were better for testing toxic substances than the regular ones. Based on our experiments, they did not seem to be. Since the regular ones already work quite well, this is positive as we do not need to put extra resources into the differentiation process.

Finally, we tried to see if by imitating the 3D environment in the human body a bit more, the cultured cells could improve their ability to react to the toxic substances. Cell lines in the plastic containers are only provided with 2 dimensions and no 3D matrix to stick to. We used a special plastic container that contained a matrix of plastic fibers, imitating a 3D environment. In our first experiment, we observed that cells cultured in regular plastic containers seemed to react more sensitively to the toxic substances, but we need to do more experiments to be sure about why.

This work can be used in the future to reduce animal content for cultivating in cell culturing without interfering with the results.