

Microfluidics for Research on Pancreatic Islets

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The Freshly Excised Pancreas





The Islet of Langerhans – the Pancreatic Islet





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Collagenase Isolation of Pancreatic Islets









Measurement of Insulin Secretion by Batch Perifusion





Measurement of Oxygen Consumption by Batch Perifusion





Perifusion Chamber for Microfluoromety





Conventional Microperifusion







Islet NAD(P)H- and FAD-Autofluorescence



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The Microfluidic Chip for Islet Perifusion - Prototype





Sequence of Wells of Increasing Depth





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Requirements

The wells should be deep enough to hold the islets firmly in place, but not so deep as to impede medium exchange

The flow rate should be fast enough to permit complete medium exchange in the vicinity of the islets,

but not so fast as to dilute the secreted hormones beyond measurabilty



Deposition of Beads Depending on Flow Rate and Well Depth (1)





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Deposition of Beads Depending on Flow Rate and Well Depth (2)





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Medium Exchange in Dependence on Flow Rate and Well Depth (1)



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Medium Exchange in Dependence on Flow Rate and Well Depth (2)





Distribution of Islets Depending on Flow Rate and Well Depth





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Simultaneous Measurement of NAD(P)H-Autofluorescence and Oxygen Consumption





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The Combined Chip - How it May Look





Conclusion

A combination of well depth and medium flow rate could be defined which permits stable recordings.

Simultaneous measurements of (UV-excited) fluorescence and oxygen consumption of the islets are possible

Future challenges:



- Valve control of channel perfusion
- Parallel channel design
- Further integration of oxygen sensor spots



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