Monitoring the products of *in vitro* rice starch digestion using capillary electrophoresis without any sample preparation

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Gold statement
- The resolution of CE separation of glucose, maltose, and maltotriose was significantly improved
- The sugars released from *in vitro* rice starch digestion were efficiently monitored online
- The overall throughput of separations was significantly increased

Introduction
Starchy foods are a major staple in human nutrition, with rice alone regularly consumed by more than half of the global population. CE has increasingly garnered wide interest for the application to food analysis and foodomics largely due to its cost-effectiveness while retaining a high level of molecular separation and efficiency [1]. We previously showed that free solution CE can be used to monitor sugars in bioethanol fermentations with little to no sample preparation [2]. We are now applying this capillary electrophoresis technique for online monitoring of the *in vitro* digestion of rice starch.

Body
Starch is a branched glucose homopolymer that when ingested undergoes a complex series of physical and biochemical digestion processes to breakdown the polymer to generate glucose. Hence, the digestibility of starch has important implications for an individual's health such as maintaining blood glucose levels to reduce the risk of type 2 diabetes.

A number of methods exist to monitor glucose release, such as the glucometer, which is quick, easy and can be directly applied to blood. While suitable for monitoring glucose in blood, its narrow working range is not suitable in an *in vitro* digestion experiment. There are also alternative biochemical markers of digestibility that can be monitored through a separation method. However, methods such as high-performance liquid chromatography (HPLC) require tedious sample preparation which prevents online monitoring via an autosampler.

This study evaluates the ability of CE to monitor sugar release during real-time enzymatic *in vitro* digestion of rice starch. CE was used to monitor the release of glucose and precursor di- and trisaccharides: maltotriose and maltose, as alternative digestibility markers that may further our understanding of carbohydrate digestibility.

Conclusion
Separation resolution between maltose and maltotriose improved from valley-to-peak ratio of ≥80% to ≤5% at 2 $g.L^{-1}$. Implementing sequential continuous injections increased overall throughput by a factor of four. Sugars can be identified with ≤1% RSD on the electrophoretic mobility and can be quantified with ~10% RSD on peak area and concentration.

References
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