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NMR-based metabonomics approaches for the assessment of the metabolic impact of dietary polyphenols on humans

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Dietary polyphenols, as present in for example tea, fruit and vegetables, are associated with several beneficial health effects. Most evidence is still based on epidemiological studies. So far, most nutritional intervention studies on dietary polyphenols are directly focused on pre-identified markers for intake, typically intact polyphenols and/or their conjugates. In recent years the role of colonic microbiota as a metabolically versatile biological digester of polyphenols has been recognized. Due to the sheer complexity of the polyphenol bioconversion by gut bacteria, and the further metabolism in human tissues, conventional targeted approaches are not adequate. Metabonomics is now taking a firm position within nutritional research, since it can provide evidence on metabolic effects of nutritional interventions in a non-biased and comprehensive manner. Dietary interventions have relatively small effects, however, compared to the large metabolic variations associated with lifestyle, gender and genotypes. In order to handle these multiple sources of variation, we tightly integrated design of intervention trials, metabolic profiling by NMR and multi-variate data-analysis techniques. The dietary interventions involved both long (4 weeks) term intake of grape/wine extracts and green/black tea, as well as single bolus doses of a grape/wine extract and black tea. NMR profiling (at 600 MHz) was able to detect a range of phenolic acids as predominant bioconverted polyphenolic products in urine in the tens of μM to the mM concentration range. Different polyphenol sources (grape/wine, green/black tea) produced different patterns of phenolic acids. Furthermore, single bolus dosing allowed detailed analysis of gut bioconversion kinetics of polyphenols. The inter-individual variation in gut microbial bioconversion kinetics was large and may be attributed to differences in microbial diversity between the different subjects.