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Quantification of dietary biomarkers in spot urine samples reflects the intake of foods of UK high public health importance

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An understanding of causal relations between diet and health is hindered by the lack of robust biological markers of food exposure⁽¹⁾. The rapid development of metabolomics technology offers opportunity for the identification of urine biomarkers for the intake of a range of foods of high public health importance^{(2), (3)}. Using high mass resolution mass spectrometry and machine learning data analysis, we have discovered potential urinary biomarkers in controlled clinical studies with a range of analytical techniques⁽²⁾. To have utility for population monitoring, we aim to validate biomarker performance in free-living individuals using urine samples collected in the home with a minimal impact on normal daily activities.

Two complementary multiple reaction monitoring (MRM) routines using triple quadrupole mass spectrometry (QQQ-MS) have been developed to quantify concurrently dietary exposure biomarkers of more than 20 foods of high public health importance in the UK. MRM quantification of metabolite levels in spot urines collected either before bed time or a first morning void identified a sub-set of potential biomarkers that demonstrated robust linkage with reported dietary intake (examples in Table 1). Figure 1 demonstrates the ability of selected biomarkers to report exposure in relation to muscle meat intake from lunch time to bedtime (Beefburger; 106gm, Chicken breast; 130gm; Processed Ham; 40.5 gm) in 6 free-living individuals. Anserine was strongly, and specifically, associated with poultry intake, whilst the urinary outputs of 3-methyl histidine and carnosine reflect striated muscle intake, with levels substantially reduced when meals contain lower quality, and processed, meats with reduced levels of striated muscle content.

Table 1.

Biomarker	Dietary Component
L-Anserine	Muscle meat
Carnosine	Muscle meat
3-methylhistidine	Muscle meat
Tartarate	Grapes
DHPPA-3-sulfate	Wholegrains
D,L-Sulforaphane-N-acetyl-L-cysteine	Cruciferous vegetables
Proline betaine	Citrus fruits
Hydroxyphenylvalerolactone	Procyanidin-rich foods
Hippuric acid	Fruit and vegetables

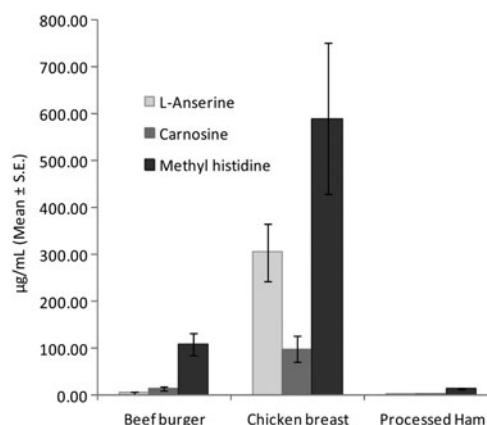


Fig. 1.

The demonstration of the utility of spot urine samples, in combination with robust quantification methods for candidate biomarkers that report multiples components of the UK diet, will allow the future validation of dietary biomarker technology in epidemiological studies.

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1 Penn *et al.* (2010) *Genes Nutr* 5:205–13.

2 Lloyd *et al.* (2011) *Am J Clin Nutr* 94:981–91

3 Beckmann M *et al.* (2013) *Proc Nutr Soc.* 72:352–61.