

# Analytical evaluation of bioavailability of functional food compounds

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In order to clarify the bioavailability of functional food components, which was considered essential to demonstrate their physiological functionalities, we have developed various unique analytical techniques. Derivatization-aided mass spectrometry (MS) for highly sensitive analysis of trace amounts of food components in blood and organs after absorption into the body, and highly sensitive MS imaging technique that can visualize their distribution on the tissues were developed. Furthermore, we developed new matrix reagents that significantly reduced noise signals in low  $m/z$  range, efficiently ionize and visualize neutral molecular species (such as polyphenols) with low detection sensitivity by MS; and provide quantification capability, which is considered a problem in MS imaging.<sup>1)</sup> These analytical research results are indispensable for elucidating the mechanism of food functionalities with a consideration of their bioavailability.

Based on these unique analytical techniques, we have clarified the absorption and metabolism of peptides and polyphenols in the body and their accumulation in organs.<sup>2)</sup> Among the findings, it is worth mentioning results based on these analytical techniques that a dipeptide, Tyr-Pro, accumulated in brain tissue through the crossing blood-brain barrier, which strictly controls substance transport to the brain, and is effective in improving memory impairment in Alzheimer's model mice.<sup>3)</sup>

We also applied these analytical techniques for the development of methods for early detection and diagnosis of diseases. It has been demonstrated for the first time that breast cancer cell lines produced high levels of medium-chain unsaturated fatty acids, which would be a candidate for a biomarker of breast cancer diagnosis. In addition, we are developing a new MS technology that enables simultaneous and comprehensive analysis of taste and odor components in foods by graphite carbon black assisted-MS system.

As described above, these analytical approaches to food function and quality evaluation based on unique analytical techniques will greatly contribute to the advancement of agricultural science and food science.

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2. Nguyen, H.-N. *et al.* Novel in situ visualisation of rat intestinal absorption of polyphenols via matrix-assisted laser desorption / ionisation mass spectrometry imaging. *Sci. Rep.* **9**, 3166 (2019).
3. Tanaka, M. *et al.* Brain-transportable soy dipeptide, Tyr-Pro, attenuates amyloid  $\beta$  peptide<sub>25-35</sub>-induced memory impairment in mice. *npj Science of Food* **4**, 1–4 (2020).