

(様式1)

公益社団法人日本栄養・食糧学会 研究業績

<学 会 賞>

1.

研究題目:(和)	低分子ペプチドの吸収と生理機能に関する研究		
(英)	Study on the absorption and functions of small peptides		
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(英)	Faculty of Agriculture, Graduate School, Kyushu University, Professor		
学 位:	農学博士	最終学歴:	1991 年 3 月九州大学大学院農学研究 院
専門分野	① 栄養生理学、②栄養生化学、③分子栄養学、④公衆栄養学、⑤臨床・病態 栄養学、⑥食生態学、⑦調理科学、○⑧食品化学・食品分析学、○⑨食品 機能学、⑩食品工学、⑪食品加工・流通・貯蔵学、⑫食品衛生・安全学、⑬ 生理学、⑭生化学、⑮分子生物学、⑯臨床医学(内科系)、⑰臨床医学(外 科系) ⑱その他		
履 歴	1991 年 4 月 九州大学農学部食糧化学工学科 助手 1996 年 11 月～1997 年 9 月 ドイツ食品化学研究所(文部省在外研究員) 2000 年 4 月 九州大学農学部食糧化学工学科 助教授 2011 年 4 月 九州大学大学院農学研究院 教授 2018 年 4 月～九州大学五感応用デバイス研究開発センター センター長 現在に至る		
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2. 研究業績要旨(1,000 字以内)

摂取した食品が生体においてその機能を発揮するか否かは、吸収量、代謝・蓄積の程度によって決定される。これまでに、機能性食品因子としてジ・トリ低分子ペプチドに着目し、高血圧、動脈硬化、糖尿病、認知症予防作用を実証するとともに、新たに構築し

た種々の高感度・高選択的分析法によって生体利用性の側面からも多くの学術的成果を上げてきた。以下、これまでに明らかにしてきた研究成果を概述する。

1) 低分子ペプチドの生体調節作用

ペプチド摂取によって軽症高血圧者の血圧が改善されること、ならびに糖尿病、動脈硬化進展、アルツハイマー型認知症を改善するなど、ペプチドバイオロジーを牽引する先駆的な成果を挙げてきた。すなわち、①イワシすり身のアルカリプロテアーゼ分解物を吸着樹脂/10%エタノールによって無味無臭化し、高血圧を予防する新たな機能性ペプチド画分の調製に成功している。②血圧低下作用を示すジペプチドの作用機構は血管を作用場とするカルシウムチャンネルブロッカー様作用であり、従来説であるレニン-アンジオテンシン系での ACE 阻害説を覆す新たなプチド機能を初めて報告してきた。また、ジペプチド配列によって生理作用は異なり、経口摂取によって動脈硬化予防作用や認知症改善作用があることを示している。

2) 低分子ペプチドの生体利用性とその評価法の構築

アミン誘導体化カラムスイッチング HPLC 法や質量分析法などのペプチドの高感度分析を可能とする分析法を構築し、摂取したペプチドがそのままの形で体内吸収され、臓器蓄積することを世界に先駆けて実証している。また、in situ での臓器蓄積評価を可能とする MALDI-MS イメージング法を設定し、摂取したジペプチドが血液脳関門を通過し、脳実質に蓄積することを初めて実証している。

3) ペプチド機能を予測できる in silico 法の食科学研究への展開

リガンドペプチドの生理機能予測を可能とする分子動力学的予測法を食機能研究に導入し、7 回膜貫通型受容体であるアディポネクチン受容体の設計と MD シミュレーションを実施し、糖尿病改善に資するアディポネクチン様ペプチドの分子設計に成功している。

以上の研究成果は、生理作用と生体利用性の両面からの追究が食機能を評価する上で重要であることを示している。

3. 報文等リスト(*日本栄養・食糧学会誌掲載分)

(1) この研究に直接関連するもの(10 編以内)

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- 3) M. Tanaka, S. Dohgu, G. Komabayashi, H. Kiyohara, F. Takata, Y. Kataoka, T. Nirasawa, M. Maebuchi, **T. Matsui**: Brain-transportable dipeptides across the blood-brain barrier in mice.

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- 5) C. Hashimoto, Y. Iwaihara, S.-J. Chen, M. Tanaka, T. Watanabe, **T. Matsui**: Highly-sensitive detection of free advanced glycation end-products by liquid chromatography-electrospray ionization tandem mass spectrometry with 2,4,6-trinitrobenzene sulfonate derivatization. *Anal. Chem.*, **85**, 4289–4295 (2013).
- 6) **T. Matsui**, T. Ueno, M. Tanaka, H. Oka, T. Miyamoto, K. Osajima, K. Matsumoto: Antiproliferative action of an angiotensin I-converting enzyme inhibitory peptide, Val-Tyr, via an L-type Ca^{2+} channel inhibition in cultured vascular smooth muscle cells. *Hypertension Res.*, **28(6)**, 545–552 (2005).
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- 9) ***松井利郎**, 川崎晃一：食品タンパク質由来機能性ペプチドによる血圧降下作用－イワシペプチド(Val-Tyr)による降圧食品の開発を中心として－. *日栄食誌*, **53(2)**, 77–85 (2000).
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(2)その他の論文(編数制限なし)

- 1) C. Abe, A. Soma, T.N.N. Tun, Y. Zhang, Y. Nishitani, H. Kayaki, H. Kawakami, **T. Matsui**: Pharmacokinetic profiles of 3-(4-hydroxy-3-methoxyphenyl) propionic acid and its conjugates in Sprague-Dawley rats. *Biosci. Biotechnol. Biochem.*, **87(5)**, 516–524 (2023).
- 2) K. Sanematsu, M. Yamamoto, Y. Nagasato, Y. Kawabata, Y. Watanabe, S. Iwata, S. Takai, K. Toko, **T. Matsui**, N. Wada, N. Shigemura: Prediction of dynamic allostery for the transmembrane domain of the sweet taste receptor subunit, TAS1R3. *Commun. Biol.*, **6**, 340 (2023).
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- 7) Y. Zhang, C. Abe, K. Ochiai, **T. Matsui**: Tissue distribution of orally administered prenylated isoflavones, glyceollins, in Sprague-Dawley rats. *J. Agric. Food Chem.*, **69(49)**, 15165–15174 (2021).
- 8) X. Sheng, M. Tanaka, R. Katagihara, M. Hashimoto, S. Nagaoka, **T. Matsui**: A novel approach for simultaneous analysis of peptide metabolites from orally administered glycinin in rat bloodstream by a coumarin-tagged MALDI-MS. *J. Agric. Food Chem.*, **69(49)**, 14840–14848 (2021).
- 9) B. Li, L. Fu, R. Kojima, A. Yamamoto, T. Ueno, **T. Matsui**: Theaflavins prevent the onset of diabetes through ameliorating glucose tolerance mediated by promoted incretin secretion in spontaneous diabetic Torii rats. *J. Funct. Foods*, **86**, 104702 (2021).
- 10) K. Nakagawa, M. Tanaka, T.H. Hahm, H.N. Nguyen, **T. Matsui**, Y.X. Chen, Y. Nakashima: Accumulation of plasma-derived lipids in the lipid core and necrotic core of human atheroma: imaging mass spectrometry and histopathological analyses. *Arterioscler. Thoromb. Vasc. Biol.*, **41(11)**, e498–e511 (2021).
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- 13) X. Sheng, S. Nagaoka, M. Hashimoto, Y. Amiya, M. Beppu, K. Tsukamoto, E. Yanase, M. Tanaka, **T. Matsui**: Identification of peptides in blood following oral administration of β -conglycinin to Wistar rats. *Food Chem.*, **341**, 128197 (2021).

- 14) T.H. Hahm, M. Tanaka, H.N. Nguyen, A. Tsutsumi, K. Aizawa, **T. Matsui**: Matrix-assisted laser desorption/ionization mass spectrometry-guided visualization analysis of intestinal absorption of acylated anthocyanins in Sprague-Dawley rats. *Food Chem.*, **334**, 127586 (2021).
- 15) B. Li, L. Fu, C. Abe, A.M. Nectoux, A. Yamamoto, **T. Matsui**: Theaflavins inhibit glucose transport across Caco-2 cells through the downregulation of the Ca²⁺/AMP-activated protein kinase-mediated glucose transporter SGLT1. *J. Funct. Foods*, **75**, 104273 (2020).
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- 21) H.N. Nguyen, M. Tanaka, B. Li, T. Ueno, H. Matsuda **T. Matsui**: Novel in situ visualisation of rat intestinal absorption of polyphenols via matrix-assisted laser desorption/ionisation mass spectrometry imaging. *Sci. Rep.*, **9(1)**, 3166 (2019).
- 22) H. Chung, S. Tajiri, M. Hyoguchi, R. Koyanagi, A. Shimura, F. Takata, S. Dohgu, **T. Matsui**: Analysis of catecholamines and their metabolites in mice brain by liquid chromatography-mass spectrometry using sulfonated mixed-mode copolymer column. *Anal. Sci.*, **35(4)**, 433–439 (2019).
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(3) 過去 5 年間の本学会での活動状況

- ① 日本栄養・食糧学会誌編集委員会委員(2020 年 5 月～現在)
- ② 日本栄養・食糧学会 用語編集委員会委員(2020 年 5 月～現在)
- ③ 日本栄養・食糧学会宇宙食専門認定制度検討委員会 副委員長(2022 年 5 月～現在)
- ④ 九州・沖縄支部参与(2010 年～現在)
- ⑤ 国際栄養学会(2nd IUNS-ICN2022, Tokyo)プログラム委員(Track 7)(2019 年 4 月～2023 年 1 月)
- ⑥ 第 78 回日本栄養・食糧学会大会 (2024 年 5 月) 実行委員会委員
- ⑦ 大会シンポジウム関係
2023 年 5 月 第 77 回日本栄養・食糧学会大会シンポジウム (食品タンパク質由来の健康機能性ペプチド研究の最前線) (企画・世話役) および講演 (脳移行ペプチドの現状と今後)
2020 年 5 月 第 74 回日本栄養・食糧学会大会シンポジウム (食科学研究を支える「ぶんせき」力の今) (企画・世話役) および講演 (食品成分の吸収と MS 分析)
- ⑧ 大会座長
第 74 回大会、第 75 回大会、第 76 回大会

(4) 特記事項

受賞関係

- 1) 2016 年 平成 28 年度日本栄養・食糧学会技術賞「混合揉捻法を活用したヘスペリジン可溶化技術の開発」(宮田裕次、田中 隆、田中一成、松井利郎)
- 2) 2020 年 2019 年度 (令和元年度) 第 24 回安藤百福賞優秀賞「ジペプチドの健康維持機能に関する研究」
- 3) 2023 年 2022 年度 (令和 4 年度) 飯島藤十郎食品科学賞「ペプチドの生体調節機能と生体利用性に関する分析化学的研究」
- 4) 2023 年 2023 年度 (令和 5 年度) 文部科学大臣表彰 科学技術賞 (開発部門)「高血圧予防を基幹とする機能性ペプチド素材の開発」

その他学術団体からの受賞 5 件