Electronic Supplementary Material of: Biomarkers of fried food intake: a systematic review of *in vivo* studies

Appendix S1

Systematic review protocol

Title

Identification

Systematic review protocol of "Biomarkers of fried food intake: a systematic review of *in vivo* studies"

Update

None

Registration

Not registered

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Contributions

Aline Gabrielle Alves de Carvalho and Luana Oeby de Oliveira: Conceptualization; Screening of articles; Writing – Original Draft.

Gabriela Raquel Amaral Soliz and Maria Fernanda Guimarães: Screening of articles.

Fabio de Almeida Oroski and Hygor Marcos Ribeiro de Souza: Writing – Review & Editing.

Alexandre Guedes Torres, Vanessa Naciuk Castelo-Branco and Tatiana El-Bacha: Conceptualization; Writing – Review & Editing; Supervision; Funding acquisition; Guarantor of the review.

Amendments

None

Support

Sources

This research was funded by grants from Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ), Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES). This work was supported by FAPERJ under Grants E-26/201.161/2021, E-26/200.930/2022, and E-26/211.280/2021; CNPq under Grants 315579/2021-8, and 314971/2021-1; and CAPES under Grant Finance code # 001

Sponsor

Not applicable

Role of sponsor/funder

This work was supported by public research funding agencies that had no role in the review protocol.

INTRODUCTION

Rationale

Fried food can contain deleterious substances formed by extensively heating or repeated frying processes. Biomarkers of fried food intake are usually determined based on questionnaires of food intake frequency, recalls or food records. The identification of biomarkers originated by fried food intake, obtained by intervention studies, enable the measurement of the exposure objectively, reinforcing nutritional epidemiology associations studies. This area still requires more investigation and comprehension, to better understand how the consumption of a particular fried food or fried food group, can cause a physiological impact and possible influence on susceptibility to diseases.

Description:

Systematic Review on *in vivo* studies that aim on biomarkers of fried food intake with discrimination by metabolomics.

Objective:

To determine metabolites from *in vivo* studies related to fried food intake, obtained by mass spectrometry-based metabolomics techniques to identify biomarkers of fried food intake.

Main question:

Which metabolites could be considered biomarkers of fried food consumption on *in vivo* studies, evaluating the evidence based on the study design, the specimens and metabolomic approach used.

Primary study:

A primary study was conducted by a previous systematic review, initially from 2001 to 2021, in the following databases: Cochrane Library, PubMed Central (PMC), PubMed, Science Direct, Scopus, and Web of Science. The free-text terms ant its combinations: “fried" OR "frying" AND "metabolome" OR "metabolomic" OR "metabolomics" were used on the article’s search and included according to the following eligibility criteria: scientific articles revised by peers and written in English, presence of free-text terms in the title, abstract, or keywords, and studies that investigated fried oils or food intake biomarkers, identified by metabolomics in *in vivo* models. This primary study reinforced the need of further studies to define possible biomarkers of potentially harmful

metabolites related to fried food intake, supporting new proposals for guidelines and public policies favoring human well-being.

Article type: Original article, reviews were not included.

Year of publication range: 2017 to 2025

Article language: English

Search strings:

Frying OR Fried OR Cook* oil OR Sauteed

AND

Metabol* OR Lipidom* OR Biomarker* OR Mass Spectrometry OR "trans fatty acid" OR acrylamide OR acrolein OR "oxid* product*"

AND

consumption OR fed OR diet-fed OR intake

Search date: publications from 1 January, 2017 to 19 March, 2025.

Search strings for each database and their results

Web of Science – Title, abstract, keywords and keywords plus (topic) search – 805 results

((TS=(Frying OR Fried OR Cook* oil OR Sauteed)) AND TS=(Metabol* OR Lipidom* OR Biomarker* OR Mass Spectrometry OR "trans fatty acid" OR acrylamide OR acrolein OR "oxid* product*")) AND TS=(consumption OR fed OR diet-fed OR intake)

PubMed – Title and abstract search – 316 results

((Frying[Title/Abstract] OR Fried[Title/Abstract] OR Cook* oil[Title/Abstract] OR Sauteed[Title/Abstract]) AND (Metabol*[Title/Abstract] OR Lipidom*[Title/Abstract] OR Biomarker*[Title/Abstract] OR Mass Spectrometry[Title/Abstract] OR "trans fatty acid"[Title/Abstract] OR acrylamide[Title/Abstract] OR acrolein[Title/Abstract] OR "oxid* product*"[Title/Abstract])) AND (consumption[Title/Abstract] OR fed[Title/Abstract] OR diet-fed[Title/Abstract] OR intake[Title/Abstract])

Ebscohost (Food Science Source and FSTA - Food Science and Technology Abstracts databases)

Search mode: boolean/phrase was chosen, apply equivalent topics option was selected, results limited to full text and publication year range from January of 2017 to May of 2024, published in English. Results from Food Science Source were limited to article from academic journals. Results from FSTA - Food Science and Technology Abstracts were limited to journal articles and standard, published from 2017 to 2025.

Search by abstract – 177 results:

AB (Frying OR Fried OR Cook* oil OR Sauteed) AND AB (Metabol* OR Lipidom* OR Biomarker* OR Mass Spectrometry OR "trans fatty acid" OR acrylamide OR acrolein OR "oxid* product*") AND AB (consumption OR fed OR diet-fed OR intake)

Search by title – 4 results:

TI (Frying OR Fried OR Cook* oil OR Sauteed) AND TI (Metabol* OR Lipidom* OR Biomarker* OR Mass Spectrometry OR "trans fatty acid" OR acrylamide OR acrolein OR "oxid* product*") AND TI (consumption OR fed OR diet-fed OR intake)

Total of searched articles: 1302

Total of duplicated articles: 352

Total of articles to filter: 948

Total of selected articles after reading title/abstract: 6

Total of selected articles after reading the full text: 4

Added by Snowballing: 1

Inclusion criteria: 1) original scientific articles revised by peers, 2) articles written in English, 3) publications within the range of 1 January, 2017 to 19 March, 2025, 4) presence of strings terms in the title, abstract, or keywords, 5) studies that have carried out food frying experiments and implemented an intervention offering the fried food, or a feed produced with the frying oil in *in vivo* studies (human or animals), followed by analysis of fluids resulting from this intervention by mass spectrometry-based metabolomics techniques to identify biomarkers of fried food intake. Excluding criteria were: 1) review articles, 2) studies that did not offer fried food to participants, 3) studies that did not use metabolomics to identify, or putatively identify, biomarkers.