



Polyphenols and health

Kevin D. Croft *^a and Cesar G. Fraga*^{b,c,d}

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Research in the field of polyphenols and their impact on health and disease has evolved considerably over the past decades.¹ Not only has there been an exponential growth in the number of papers published, but also our understanding of these compounds has evolved from seeing them as simple antioxidants to recognising diverse bioactivity.² In accordance, related disciplines, such as food chemistry, nutrition and medicine, started considering polyphenols as potential health promoters and inclusive, therapeutic agents.

Encompassing this evolution, this thematic issue of *Food and Function* displays a collection of papers ranging from basic studies in food and animal models and humans, to the latest reviews of epidemiological evidence. The articles are distilled from the symposium titled 'Polyphenols: the road from plants to functional foods' held during the 9th International Conference on Polyphenols and Health (ICPH). The issue includes not only presentations from this symposium, but also work

from select participants of the conference. Overall, we were fortunate in obtaining a collection of articles written by leading active groups in the field of polyphenols and health.

Investigations on polyphenols today include, and try to make compatible, basic chemical characterization and chemical reactions in food and living systems, mechanisms of biological relevance, and protection from the development and consequences of diseases. This basic research, helped by the advent of reliable databases for polyphenol content of foods, has given rise to large epidemiology studies on fruit and vegetable consumption indicating reduced risk of some cancers and cardiovascular and metabolic disease with increased dietary polyphenol intake. As a result, it has stimulated huge interest in healthy foods and supplements and a need to understand the absorption and metabolism of polyphenolic compounds, their target(s) in biological systems, and the results of the interactions with those targets.

In this issue, a group of studies describe the analysis of polyphenols in foods and dietary supplements, and the likelihood that they can impact human health positively (Bussy *et al.*, DOI: 10.1039/C9FO02762A; van Rijs and Fogliano, DOI: 10.1039/D0FO01158D; Bondonno *et al.*, DOI: 10.1039/D0FO01130D; Kan *et al.*, DOI: 10.1039/D0FO01145B). A second group of papers are original research in *ex vivo* and small

animal models that are used as a means to understand potential mechanisms on how polyphenols or their metabolites influence disease. In this group we include several papers studying the bioavailability of polyphenols (Pereira-Caro *et al.*, DOI: 10.1039/D0FO00350F; Monfoulet *et al.*, DOI: 10.1039/D0FO00346H; Favari *et al.*, DOI: 10.1039/D0FO00806K; Anacleto *et al.*, DOI: 10.1039/D0FO01839B) as well as the functional effects of flavonoids such as (–)-epicatechin in mouse models (Hid *et al.*, DOI: 10.1039/D0FO01148G; Prince *et al.*, DOI: 10.1039/C9FO02234A; Kang *et al.*, DOI: 10.1039/D0FO00486C) and one work on the metabolism of polyphenols by specific human-gut bacteria (García-Villalba *et al.*, DOI: 10.1039/D0FO01649G). This compilation of research is just a sample of the extensive fundamental research present in the literature that gives a strong pre-clinical base for intervention studies. Unfortunately, such intervention-based research is still scarce, pointing out the need for more human studies, which have to be based on the use of well-defined dietary polyphenols and realistic models applicable to specific disease conditions. Such human studies are important, as the bioavailability and metabolism of polyphenols in humans may differ from that in animals, and also because of individual differences in polyphenol metabolism due to a number of factors including the gut microbiome.³

^aSchool of Biomedical Science, University of Western Australia, Perth, Western Australia, Australia.

E-mail: kevin.croft@uwa.edu.au

^bFisicoquímica, Facultad de Farmacia y Bioquímica, Universidad de Buenos Aires, Buenos Aires, Argentina.

E-mail: cfraga@ffyb.uba.ar

^cInstituto de Bioquímica y Medicina Molecular (IBIMOL), Universidad de Buenos Aires-CONICET, Buenos Aires, Argentina

^dDepartment of Nutrition, University of California, Davis, CA 95616, USA. E-mail: cgfraga@ucdavis.edu

The collection is completed with key review articles, including systematic reviews and meta-analysis of randomised trials (Cheok *et al.*, DOI: 10.1039/D0FO00537A; Parmenter *et al.*, DOI: 10.1039/D0FO01118E), and revision of evidence from large population cohorts (Sun *et al.*, DOI: 10.1039/C9FO01747J). Also part of this group of papers, is work on the use of bioinformatic analysis of nutrigenomic data obtained in cells (Ruskovska *et al.*, DOI: 10.1039/D0FO00701C). Other reviews cover relevant unhealthy conditions, including studies on cardiovascular risk, metabolic diseases (diabetes) and neurological stress (Williamson, DOI: 10.1039/D0FO01168A; Yamashita *et al.*, DOI: 10.1039/D0FO01092H; John *et al.*, DOI: 10.1039/D0FO01133A; Sakakibara and Shimoi, DOI: 10.1039/D0FO01129K).

Clearly, a lot has been done in terms of polyphenols and health, but also a lot remains to be done. Today, based on the presented data and on the extensive literature available, we 'perceive' that polyphenols have a positive effect on human health. However, we need more defini-

tive human data before it is possible to give precise answers on which compound, in what amount, and for what disease, the consumption of that polyphenol is of benefit. As mentioned, more human intervention studies (chronic or long term if possible) are needed, guided by the importance of the disease condition, and coupled with mechanistic studies based on realistic concentrations of polyphenols or their metabolites in the organ/system under study. The concretion of this complex matrix of research, is definitively necessary for the advance our understanding in this field.

Finally, we would like to recognize the trigger of this issue: the 9th ICPH. Held in Kobe, Japan, from November 28 to December 1, 2019, this conference was lead by Professors Hitoshi Ashida (Kobe University) and Kayoko Shimoi (University of Shizuoka) as joint Presidents. They put together an exciting programme that developed into a superb meeting, in terms of scientific quality and global attendance. ICPHs are key meetings gathering leading scientists

and showing the latest developments in the research relating to polyphenols and health. The coming 10th ICPH will be held in London at the end of 2021, and will be organised by Professor Jeremy Spencer (University of Reading). We hope it will be a place for demonstrating new insights aimed to solidify the association between polyphenols and human well-being.

References

- 1 F. Perez-Vizcaino and C. G. Fraga, Research trends in flavonoids and health, *Arch. Biochem. Biophys.*, 2018, **646**, 107–112.
- 2 C. G. Fraga, K. D. Croft, D. O. Kennedy and F. A. Tomas-Barberan, The effects of polyphenols and other bioactives on human health, *Food Funct.*, 2019, **10**(2), 514–528.
- 3 A. Cassidy and A. M. Minihane, The role of metabolism and the microbiome in defining the clinical efficacy of dietary flavonoids, *Am. J. Clin. Nutr.*, 2017, **105**(1), 10–22.