

## A Current Shot and Re-thinking of Antioxidant Research Strategy



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Antioxidant properties are an expression of the interactions between bioactive molecules and other components of a food matrix and they can be considered as the first action for the comprehension of potential beneficial properties of food matrices in the perspective of healthy choices.

In this regard, it is important to underline how the identification, isolation, and quantification of biologically active compounds present in food matrices is required as starting point in the study of antioxidant properties and this is followed by assessment of their interactions. The actual possibilities for approaching a study about antioxidant properties in foods are summarized and described in Table I. A “study approach” is intended here as the direction of a research strategy and a design to indicate the features that one wants to investigate.

**Table I.** The main workflow for investigation of antioxidant properties

Study Approach	Description
Study and development of a model system of interactions.	Monitoring pure bioactive compounds, standards, and their related mixtures leads to the development of a model system for interactions. The interactions can give a combined and synergistic effect, an antagonistic effect, or no additional effect. This behavior was generally affected by different variables such as the chemical structure and profile of antioxidants and also the nature and characteristics of the food matrix.
Study of extractable and non-extractable compounds.	Antioxidants arise as easily extractable compounds -free forms that are soluble in aqueous-organic solvents- and as less extractable compounds -bound forms that remain in the residue of aqueous-organic extract. In the last decade, the occurrence of antioxidants in raw and cooked foodstuffs and in processed products has been studied. Due to the concomitant action of different factors, it is difficult to identify and categorize the main trends in the contribution of extractable and non-extractable compounds to the total antioxidant capacity in main food groups. In general, research has pointed out that analysis of compounds remaining in residues is required. Particular attention should be given to high fat food matrices and complex food matrices.
Study of bioactive compounds-rich extracts.	Isolation of bioactive compounds-rich extracts and determination of their contribution to the antioxidant properties of a food matrix should be carried out. For each food, one or more fractions can be isolated and qualitatively and quantitatively characterized. In this way, the minor or major contributors to the antioxidant properties can be identified. The information from all fractions could be considered as an indicator of the antioxidant properties of a food matrix.

In recent years, these types of approaches are being carried out in several studies and in works along various food groups and at different levels of the food chain and also in less common foods. In particular, the importance of both extractable and non-extractable antioxidants has reached a consensus in the scientific community and the development and assessment of new methodologies has been achieved.

Nowadays researches, in the perspective of circular economy and biorefinery, on extractable and non-extractable antioxidants in food wastes [1,2], as well as in direction of nutraceutical applications [3, 4] are addressed.

Generally, studies on the evaluation of antioxidant properties should be integrated into a multidisciplinary and innovative study design for food research, where innovative and green procedures and technologies are combined with statistical methods. For instance, applications of infrared spectroscopy coupled with chemometrics applied to extractable and non-extractable compounds are emerging [5,6].

Also, a proper assessment of the contribution of extractable and non-extractable compounds in the dietary intake is required [7]. The overall goal is the development of dedicated databases as well as the inclusion of extractable and non-extractable compounds in harmonized food composition databases in order to an adequate dietary intake assessment. Studies on this direction are carried out in eBASIS [8].

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