Food Chemistry 218 (2017) 70–77

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Nutritional composition and antioxidant properties of traditional Italian dishes

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ARTICLE INFO

Article history:
Received 13 May 2015
Received in revised form 26 May 2016
Accepted 30 August 2016
Available online 31 August 2016

Keywords:
Traditional Italian dishes
Nutritional composition
Antioxidant properties
Dietary Reference Values
Food composition databases

ABSTRACT

This work aims at evaluating the main nutrients (proximate, minerals), their contribution for Dietary Reference Values in Italian population, and the antioxidant properties of some popular dishes prepared in a dedicated lab-kitchen: *spaghetti alle vongole, pomodori al riso, gateau di patate, carciofi alla romana, pan di Spagna.*

Results showed that nutrient contents and energy value varied extensively because of the variety and the nature of ingredients in the analyzed dishes, and thus defined different daily nutrient intakes and their association with health effects. A serving portion of either *spaghetti alle vongole* or *carciofi alla romana* showed to contribute to the daily nutritional recommendations respectively, with an appreciable percentage of available carbohydrates (30–22%) and a considerable content of dietary fibre (91%). *Gateau di patate* was particularly rich in calcium (343 mg), both contributing 34% of the recommended intake, in addition to appreciable content of phosphorus and zinc.

With regards to *spaghetti alle vongole, pomodori al riso, gateau di patate* and *pan di Spagna*, extractable polyphenols contributed less than 15% to total antioxidant activity, and hydrolysable polyphenols give a major contribution; *carciofi alla romana* showed an inverse trend. Findings provide an important contribution to the update of Italian Food Composition Databases.

1. Introduction

Nowadays, researchers try to identify the milestones of the concept of "optimal nutrition", by studying and pointing out not only properties and functions of single foods or food components, but also their combination in dishes, meals and diets, so as to understand their potential influence on health. Following the latest evolution of nutrition science, the study of food bioactivity is increasing and epidemiological studies point out the need to consider the total food matrix as a variable of interest in disease risk.

Studies on interactions between single food components and/or between the different ingredients of a composite dish, play an important role and amplify the importance of the "food synergy" concept on health (Jacobs & Tapsell, 2007). Cooked foods and composite dishes are, in fact, often used, however currently there is a significant gap in their composition information.

In human nutrition food choices depend on a wide range of factors: culture, tradition, ethics, environment, consumption patterns, personal preferences, etc. In recent years, attention has been increasingly paid to the nutritional characteristics of traditional foods and recipes (Costa, Vasilopoulou, Trichopoulou, & Finglas, 2010; Costa et al., 2013; Lombardi-Boccia & Marletta, 2008; Vasilopoulou & Trichopoulou, 2009), also through specific research projects, e.g. the EuroFIR Network (European Food Information Resource; www.eurofir.org), in order to accurately estimate dietary intake of the population, prevent diseases such as cardiovascular diseases, cancer, diabetes, etc., provide dietary information, and preserve some cultural elements. Italy is extremely rich in traditional foods and dishes, and their production has been transferred from generation to generation, thus playing an important role within local cultures.

In this context, the evaluation of antioxidant properties, in terms of antioxidant activity of compounds in a food and their possible synergistic interactions, could represent the first step in the investigation of potential benefits of food preparations and an indicator of a "possible beneficial role".

The antioxidant capacity of each food matrix comes from the combined action of bioactive compounds such as polyphenols, carotenoids, lignans, vitamins C and E, etc. Natural antioxidants could

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http://dx.doi.org/10.1016/j.foodchem.2016.08.120
0308-8146/

exert a wide range of physiological properties, such as anti-allergic, anti-atherogenic, anti-inflammatory, antimicrobial, antioxidant, anti-thrombotic, cardioprotective, and vasodilatory effects (Scalbert, Manach, Morand, & Remesy, 2005). The chemical diversity of compounds, besides their possible interactions, as well as the different mechanisms of action and biological role make difficult to assess a single and reliable procedure to evaluate antioxidant activity. Three fundamental steps should be considered in the evaluation of antioxidant properties: extraction, antioxidant capacity measurements and expression of results (Apak et al., 2013; Pérez-Jiménez et al., 2008). Chemical extraction is affected by several factors such as type of solvents, extraction time and temperature, as well as by the chemical composition and physical characteristics of the analyzed sample (Luthria, 2006).

With the aim to obtain an optimal procedure for the antioxidant extraction, several researches have tested different solvents, i.e. ethanol, methanol and acetone and/or their mixtures (Liyana-Pathirana & Shahidi, 2006; Velioglu, Mazza, Gao, & Oomah, 1998); in particular, the use of an acid mixture of methanol/water improve the extraction capacity of antioxidant compounds (Iqbal, Bhanger, & Anwar, 2005; Rufino et al., 2010). Recent researches have also performed alkaline hydrolysis, acid hydrolysis or enzymatic digestion (Bennet et al., 2010; Delgrado-Andrade, Conde-Aguilera, Haro, de la Cueva, & Rufian-Henares, 2010).

The investigation and distinction between extractable and non-extractable antioxidants have received much attention in recent years and represent a key element in the definition of the healthy properties of food matrices in terms of prevention of diseases. Easily extractable compounds (free forms) were solubilized by aqueous-organic solvents, whereas less extractable compounds were in bound forms, remaining in the residue of aqueous-organic extract (Saura-Calixto, 2012). Non extractable antioxidants comprised hydrolysable tannins and other phenolics bound to carbohydrates and proteins, as well as macromolecules, such as condensed tannins (proanthocyanidins). These compound classes were obtained from two specific and different hydrolytic treatments of the residue (Pérez-Jiménez, Diaz-Rubio, & Saura-Calixto, 2013; Pérez-Jiménez & Torres, 2011).

At the same time, few studies have been carried out on the antioxidant properties of complex food matrices and ready-to-eat dishes (Greco, Riccio, Bergero, Del Re, & Trevisan, 2007; Ioannou, 2012), whereas numerous data on single ingredients are available in literature, but unfortunately they do not take into account either the formulation or the effects of the technological process (Pennington, 2002).

One of the aims of this work is the provision of new and reliable data on the nutritional composition of some popular Italian dishes that are commonly consumed and therefore represent the Italian traditional cuisine, and assessment of their nutritional contribution to the recommended intakes.

By following the guidelines produced by EuroFIR Network of Excellence, the composition data produced may be included in the Italian National Food Composition DataBase. Moreover, this study evaluates the contribution of extractable and non-extractable bioactive compounds on the antioxidant properties of these dishes, for a better understanding of their nutritional role, and provides additional dietary information.

2. Materials and methods

2.1. Recipes

All procedures for the generation of new reliable nutritional data on traditional dishes were carried out following a standard methodology developed within the EuroFIR.

Identification of commonly-consumed recipes – Five dishes consumed in Italy and that represent different food types and cooking techniques were selected for this study. They were identified on the basis of the nationwide food consumption survey INRAN-SCAI 2005–2006 (Leclercq et al., 2009) and were studied within a broader project (QUALIFU-SIAGRO) concerning the nutritional characterization of several popular and most commonly consumed Italian dishes. In addition, these recipes were selected, by considering various ingredients, mostly staple, including pasta, rice, potatoes, vegetables, fish, cured meat, dairy products and eggs that cover a wide range of antioxidant properties. The chosen dishes were: *spaghetti alle vongole* (spaghetti with clams), *pomodori al riso* (rice-stuffed tomatoes), *gateau di patate* (potatoes pie), *carciofi alla romana* (stuffed artichokes), *pan di Spagna* (sponge cake). Spices and herbs were used as an ingredient in four out of five dishes, whereas fruits were not ingredients in any of them.

For every selected recipe, a document collection was carried out from the most popular and traditional cookbooks in Italy (Il cucchiaio d'argento; La cucina italiana, etc). For every dish one "standard recipe" was identified and one "preparation protocol" was elaborated in order to standardize ingredients, amounts, preparation and cooking techniques (time, temperature, utensils, etc.).

Sampling methods – The sampling plan considered the collection of simple ingredients in different retail stores, supermarkets and takeaways in Rome; ingredients for four dishes were purchased by collecting the main food brands and varieties of the same product: 8 brands of spaghetti, 7 brands of eggs, 4 brands of extra virgin olive oil, 2 brands of wheat flour and butter, 10 lots of roman artichokes (*Cynara cardunculus L. var. scolymus*), labeled as Protected Geographical Indication (PGI), and 2 lots of potatoes (*Solanum tuberosus* cv. *Agata* and *Primura*), 2 lots of species of clams coming from five Mediterranean areas (*Tapes semidecussatus* and *Chamelea gallina*) and purchased in two different seasons. *Pomodori al riso* were purchased from 8 different takeaway points.

Dish preparation – All ingredients were weighed and dry matter was expressed in grams, while volumes and fluids were expressed both in milliliters (ml) and in grams (g). Each ingredient (primary sample) was prepared (cleaning, peeling, cutting, weighing) and then combined to make a composite sample (pool) before using it for the preparation of the ready-to-eat dish. The composite sample was weighed, assembled and cooked in a laboratory and dedicated kitchen in CREA-AN by two trained persons according to the preparation protocol of the standard recipe, and common household methods and utensils were used. Identical batches, about 2 kg of each dish, were produced twice in different periods. More details (typology, ingredients, methods and time of cooking) are reported in Table 1.

After cooking, the prepared dishes were weighed once more (after 5′ at room temperature), homogenized, frozen at −30 °C and then lyophilized, for subsequent analyses, each being carried out in triplicate.

2.2. Chemicals and standards

Reagents and standards were purchased from Sigma-Aldrich Srl (Milan, Italy), Extrasynthese (Genay, France), Carlo Erba (Milan, Italy), J.T. Baker (Deventer, Holland), Megazyme International (Ireland) and BDH Laboratory Supplies (Poole, UK) and were of the analytical grade purity. Double-distilled water (Millipore, Milan, Italy), purified with a Milli-Q™ system, was used throughout the study.

2.3. Analyses

All the analyses were carried out according to official methods: moisture, protein, lipid and ash contents were determined