

# The micronutrient content of traditional Greek foods

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**Abstract** In the context of the EURRECA project (EUropean micronutrient RECommendations Aligned), we have estimated the micronutrient content of traditional Greek foods in relation to international recommendations. Many of these foods showed a rich micronutrient profile and a file was developed listing a total of 137 traditional Greek foods and dishes. This work indicates that in order to meet micronutrient requirements, a simple solution would be to adhere to traditional dietary patterns, at least for the Mediterranean populations, and reinstate traditional foods into the daily diet.

**Keywords** Traditional foods · Micronutrients · Recommended Dietary Allowance

## Introduction

Many observational epidemiological studies have indicated that particular food groups, mostly plant foods, may have beneficial effects on health [1]. More consistently, observational epidemiological studies and even some randomised intervention investigations have concluded that certain dietary patterns, in particular the plant-based Mediterranean dietary pattern, are associated with lower overall mortality and longer life expectancy [2]. Researchers have hypothesised that the apparent beneficial effect of foods, food groups or dietary patterns may be explained by the action of specific micronutrients, particularly vitamins, including vitamin A and beta carotene, vitamin C, vitamin E, vitamin D and folic acid [3].

Randomised trials, however, evaluating these macronutrients have overwhelmingly generated null results [4–7]. It is possible that methodological problems are responsible for false positive results in observational epidemiological studies or that statistical power limitations or poor compliance in randomised trials are responsible for the null results in the trials. An alternative explanation, however, is that factors other than those evaluated in randomised trials and present in the food groups, foods or dietary patterns that have been found to have beneficial health effects are responsible for these effects. The search for the identification of these unknown factors should continue but, meanwhile, consumption of foods and adherence to dietary patterns that have been reported to be health promoting should be encouraged [8–11]. This particularly applies to traditional foods that are key components of the Mediterranean diet, the pattern most consistently shown to be associated with better health. However, before promoting systematic consumption of traditional foods it is necessary

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to examine to what extent these foods cover general nutritional needs as reflected in recommended daily allowances, so that the general principle of eating a balanced diet is not compromised.

Given the fact that several traditional Greek foods have been reported to be rich sources of micronutrients [12], an attempt was made to identify how much traditional Greek foods contribute to recommended daily allowances. This work was implemented in the context of the 6th Framework Programme Network of Excellence (FP6 NoE) EURRECA (EUROpean micronutrient RECommendations Aligned) [13, 14] and more specifically in the context of Integrated Activity 2, task 2 “NoE-informed food products development”, where one of the objectives is to provide small- and medium-sized enterprises with scientific support to reassess and promote traditional foods. This paper describes the methodology that was followed for the implementation of the work that led to the development of an integrated file that may prove a useful tool in nutrition policy planning at a national level.

## Methodology

In order to formulate the working framework to identify traditional Greek foods potentially rich in micronutrients, several aspects needed to be pre-assessed. These are described below:

### The definition of “traditional foods”

In the context of the FP6 Network of Excellence EuroFIR (European Food Information Resource Network, [www.eurofir.net](http://www.eurofir.net)), a definition of “traditional foods” was established for the purposes of European Food Composition Tables [15]. EuroFIR and EURRECA intertwine and complement each other [14], as both networks are related directly or indirectly to food composition data. So the following EuroFIR definition was applied.

### *Traditional food*

Traditional means conforming to established practice or specifications prior to the Second World War. Traditional food is a food of a specific feature or features, which distinguish it clearly from other similar products of the same category in terms of the use of “traditional ingredients” (raw materials or primary products) or “traditional composition” or “traditional type of production and/or processing method”, as defined below.

### *Traditional ingredient (raw material or primary product)*

Raw material (species and/or varieties) or primary products either alone or as an ingredient that has been used in identifiable geographical areas and remains in use today (taking into account cases where use was abandoned for a time and then reinstated) and its characteristics are in accordance with current specifications of national and European Union legislation.

### *Traditional composition*

The uniquely identifiable composition (in terms of ingredients) that was first established prior to the Second World War and passed down through generations by oral or other means (taking into account cases where composition was abandoned for a time and then reinstated) and when necessary is differentiated from the composition defined by the generally recognised characteristics of the wider food group to which the product belongs.

### *Traditional type of production and/or processing*

The production and/or processing of a food that:

- has been transmitted from generation to generation through oral tradition or other means; and
- has been applied prior to the Second World War and remains in use (taking into account cases where composition was abandoned for a time and then reinstated) despite its adjustment to binding rules from national or EU food hygiene regulations or the incorporation of technological progress, under the condition that production and/or processing remains in line with methods used originally and that the food’s intrinsic features such as its physical, chemical, microbiological or organoleptic features are maintained.

### The food composition data source

Data were used from the Composition Tables of Foods and Greek Dishes, 3rd edition [16] and more specifically from Section 2, which concerns foods and sweets that are typically prepared and consumed in Greece. The composition data of traditional Greek recipes calculated through nutritional software, as well as the recipes used for the calculation, are available online (<http://www.hhf-greece.gr/tables/>).

### The micronutrients to be investigated

The EURRECA NoE has established a preliminary list of priority micronutrients. For the purpose of this work these priority micronutrients had to be linked to available composition data. So, out of the 19 micronutrients included in the preliminary EURRECA list, composition data existed only for 8 of these micronutrients in the Composition Tables of Foods and Greek Dishes. More specifically, the micronutrients investigated were calcium (Ca), phosphorus (P), zinc (Zn), vitamin C (Vit C), iron (Fe), vitamin E (Vit E), magnesium (Mg) and potassium (K).

### When foods are considered rich in micronutrients

This is dependent on the contribution the micronutrient in an individual food can make to the overall diet. It was decided by the task partners that traditional foods potentially rich in a certain micronutrient would be considered the foods that can cover at least 15% of the Recommended Dietary Allowance (RDA) of this micronutrient.

### The Dietary Reference Intake values

The Dietary Reference Intake values used for the purpose of this task are the United States Department of Agriculture (USDA) values for population groups [17] (with the exception of vitamin K, which was not included in the USDA report) and the Lowest Threshold Intake for the adult population of the European Commission (EC) report [18], since below this level, on the basis of current knowledge, all individuals may not be able to maintain metabolic integrity.

### The portion sizes of dishes

The composition data in the Composition Tables of Foods and Greek Dishes [16] correspond to 100 g of edi-

ble portion of the food. To convey this information into the nutritional composition corresponding to an actual serving of the food consumed, standardised portion sizes of the foods are needed.

All the identified traditional foods have been reported with reference to the intake of the micronutrient from 100 g of food for each population group. This value is an indication of the food's richness in the specific micronutrient. However, wherever information on standardised portion sizes of the food was available from the Greek segment of the EPIC study (The European Prospective Investigation into Cancer and nutrition, [www.nut.uoa.gr](http://www.nut.uoa.gr)), the traditional food was further reported with reference to the intake of the micronutrient from a serving for each population group.

## Results

Following the described methodology, a file was developed listing a total of 137 traditional Greek foods and dishes. The number of traditional foods listed per component and population group is presented in Table 1 for the infant, children, male and female population groups. The respective data for the pregnancy and lactation population groups are presented in Table 2. The particularities of each vulnerable population group have been considered. For this reason the number of foods listed under the infant group is apparently lower.

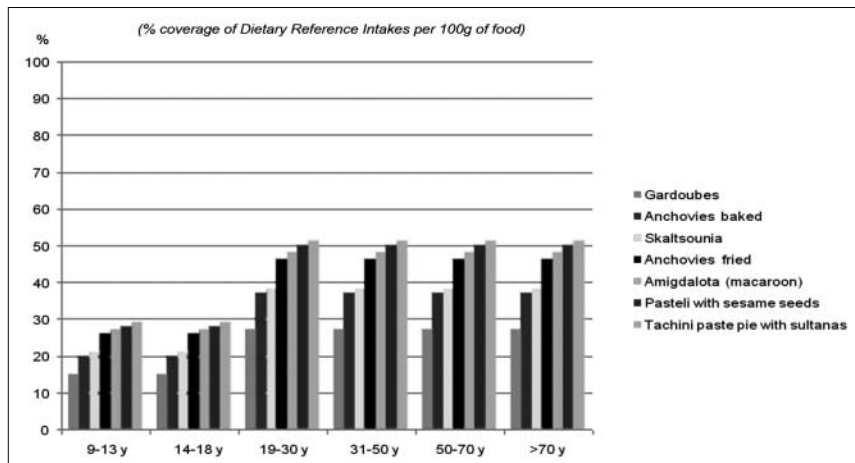
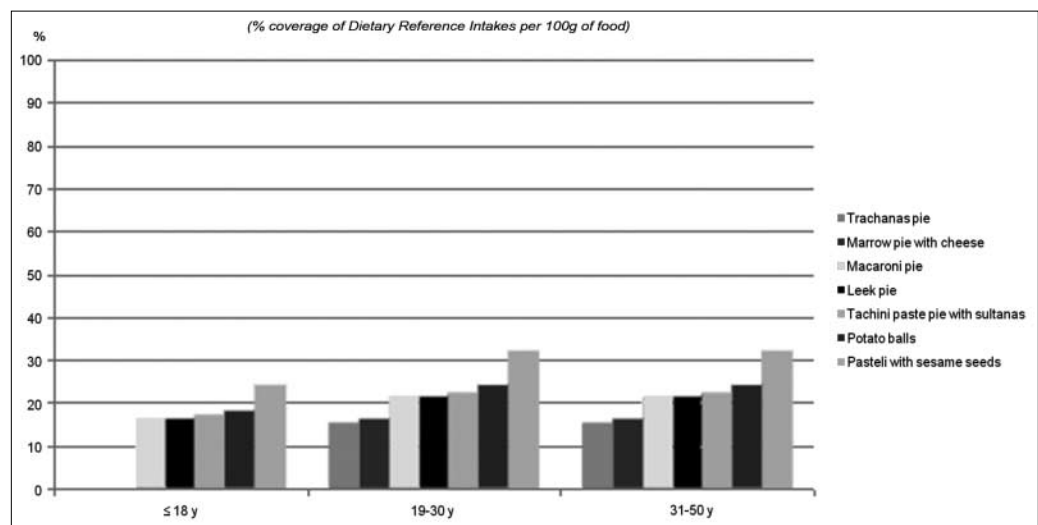
An Excel file was used to integrate the collected data. The file consists of 8 worksheets, one for each of the investigated micronutrients. Intake from portion sizes of the food is also included in the worksheets, wherever the information on portion size was available, with the exception of the infant population group. In all the other population groups, the information that is integrated into the file is (a) the food name in English, (b) the portion size, (c) the compositional data (mg/100 g), (d) the conversion of the compositional data to a serving, (e) the percentage of the RDA covered by the con-

**Table 1** Number of traditional foods listed per micronutrient by infant, children, male and female population groups

Micronutrient	Infants	Children		Male (M) and female (F) adults											
	7–12 m	1–3 y	4–8 y	9–13 y		14–18 y		19–30 y		31–50 y		50–70 y		>70 y	
				M	F	M	F	M	F	M	F	M	F	M	F
Zn	47	111	97	57	57	39	48	39	57	39	57	39	57	39	57
P	57	116	116	33	33	33	33	92	92	92	92	92	92	92	92
K				85	85	85	85	85	85	85	85	85	85	85	85
Ca	24	54	30	10	10	10	10	18	18	18	18	12	12	12	12
Fe	19	85	62	82	82	59	35	82	21	82	21	82	82	82	82
Mg	60	121	81	42	42	15	18	15	23	15	23	15	23	15	23
Vit E	43	85	70	37	37	20	20	20	20	20	20	20	20	20	20
Vit C	15	78	86	71	71	51	58	36	51	36	51	36	51	36	51

**Table 2** Number of traditional foods listed per micronutrient by pregnancy and lactation population groups

	Pregnancy			Lactation		
	≤18 y	19–30 y	31–50 y	≤18 y	19–30 y	31–50 y
Zn	32	39	39	25	32	32
P	33	92	92	33	92	92
Ca	10	18	18	10	18	18
Fe	10	10	10	62	70	70
Mg	15	18	18	18	23	23
Vit E	20	20	20	12	12	12
Vit C	41	36	36	26	26	26

**Fig. 1** Identification of traditional Greek foods potentially rich in phosphorous (P) for the male population group**Fig. 2** Identification of traditional Greek foods potentially rich in calcium (Ca) for the lactation population group

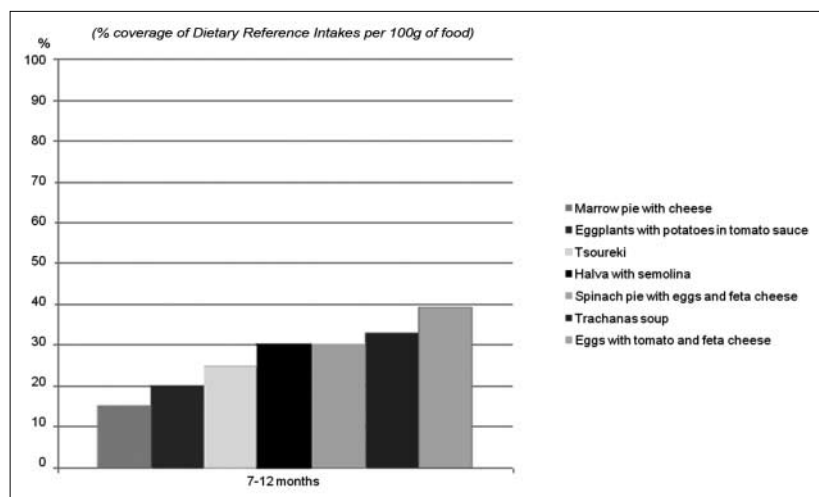
sumption of 100 g of the food and (f) the percentage of the RDA covered by the consumption of a whole serving of the food.

The intake data is displayed in ascending order, beginning from coverage of 15% of intake and upwards. This developed file is a valuable source of data on micronutrient intake from Greek traditional foods and different types of information can be selectively retrieved depending on the objective of the research.

Some indicative data on traditional foods, selectively retrieved from the developed file, is briefly presented in Figures 1–3.

## Discussion

Tables 1 and 2 indicate that many traditional Greek foods have a high potential of meeting micronutrient requirements since a large number of traditional foods are listed



**Fig. 3** Identification of traditional Greek foods potentially rich in vitamin E for the infant population group

under each micronutrient. With respect to Ca and Mg, there seems to be a trend that a smaller number of traditional foods are listed compared to the other micronutrients. However, it has been found that a weekly Greek menu is generally well balanced and meets the EC requirements of micronutrient intakes, even with respect to these micronutrients [19]. This is an indication that the issue of micronutrient recommendations should be better addressed in the context of a complete dietary pattern rather than by the consumption of individual food items.

The identification of traditional Greek foods rich in micronutrients has led to an extensive list of traditional Greek foods that meet nutrient recommendations. This integrated file could be a useful tool in nutritional planning for the Greek population, as well as in nutrition labelling, since the amount of micronutrient contained in a portion or in 100 g is expressed as a percentage of a nutrient recommendation. It is apparent that a great number of Greek traditional foods have a high potential for nutrient function claims that fall within the scope of the recent EC Regulation on Nutrition and Health Claims made on Foods [20].

A point that could result in differences in this type of work is the applied RDA values. Micronutrient recommendations differ across countries and across continents. The age cut-off points are also often classified differently between countries [14]. This work was based on the USDA values, which were established in 2006 and consequently are based on more recent scientific data compared to the EC recommendations of 1993. Since then, new scientific data have become available for some of the nutrients and their bioavailability [21], an important element when setting micronutrient recommendations. The significance of establishing solid scientifically based micronutrient recommendations has been acknowledged by the EC and the European Food Safety Authority has currently launched a public consultation on its general

approach to establishing Dietary Reference Values ([http://www.efsa.europa.eu/EFSA/PublicConsultations/efsa\\_locale-1178620753812\\_OpenConsultations.htm](http://www.efsa.europa.eu/EFSA/PublicConsultations/efsa_locale-1178620753812_OpenConsultations.htm)) using data for European populations.

Independently of the applied RDA values, however, many traditional Greek foods show a high micronutrient profile. Figure 1 presents indicative traditional foods potentially rich in phosphorous (P) for the male population group. The consumption of 100 g of traditional sweets, based on nuts and seeds such as amigdalota (macaroon), pasteli (sesame seed bar) and tachini paste pie provide around 50% of the RDA, which could be an incentive to substitute contemporary desserts rich in cholesterol and saturated fats with traditional sweets. Figure 2 presents indicative traditional foods potentially rich in calcium (Ca) in the lactation group. Different types of pies, such as trachana (frumenty) pie, marrow pie with cheese, macaroni pie and leek pie are good sources of calcium (Ca). Pies are commonly consumed in Greece either as snacks or accompanying the main meal. The presented data refer to 100 g, which is typically the portion size for one piece of pie. So, obviously by consuming a second piece the intake becomes twice as high. Figure 3 presents several traditional foods potentially rich in vitamin E in the infant group. Approximately 40% of the RDA can be covered by eggs with tomato and feta cheese, indicating how by using simple Mediterranean foods and ingredients such as tomato and feta cheese, one can end up with a nutritious dish. Naturally, all traditional Greek dishes are cooked with extra virgin olive oil, which is the centrepiece of the Mediterranean diet and on its own a good source of vitamin E.

Besides inorganic constituents and vitamins, traditional Greek foods are also rich in phytochemicals [22–24]. Adherence to the traditional Greek diet may provide the consumer with an adequate overall micronutrient supply including inorganic constituents, vitamins



and phytochemicals, thus meeting requirements for optimal health and functioning.

The beneficial health effects of the Mediterranean diet are due to the combined consumption of a variety of traditional Mediterranean foods. The value of the Mediterranean diet is accentuated nowadays as the risk of chronic diseases associated with food choices is appreciated more and more by the general population and vulnerable population groups [3]. Although the pathogenesis and effects of certain micronutrient deficiencies are recognised or suspected, the difficulties in preventing the deficiencies emphasise the need for new approaches [25]. In the area of food consumption, currently, the market offers a large variety of “functional foods”, which claim to be enriched and meet dietary requirements. This work shows that instead of seeking novel and untried approaches, a more simple solution would be to return to traditional dietary patterns, at least for the Mediterranean populations, and reinstate traditional foods into the daily diet.

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**Conflict of interest** The authors declare that they have no conflict of interest related, to the publication of this manuscript.

## References

- World Cancer Research Fund/American Institute for Cancer Research (2007) Food, nutrition, physical activity, and the prevention of cancer: a global perspective. RR Donnelley, Washington, DC
- Sofi F, Cesari F, Abbate R et al (2008) Adherence to Mediterranean diet and health status: meta-analysis. *BMJ* 337:a1344
- Hunt CD (2008) Trace elements in human diets, nutrition, and health: essentiality and toxicity. *Cell Biol Toxicol* 24:341
- Sesso HD, Buring JE, Christen WG et al (2008) Vitamins E and C in the prevention of cardiovascular disease in men: the Physicians' Health Study II randomized controlled trial. *JAMA* 300:2123–2133
- Gaziano JM, Glynn RJ, Christen WG et al (2009) Vitamins E and C in the prevention of prostate and total cancer in men: the Physicians' Health Study II randomized controlled trial. *JAMA* 301:52–62
- Lippman SM, Klein EA, Goodman PJ et al (2009) Effect of selenium and vitamin E on risk of prostate cancer and other cancers: The SELEnium and vitamin E Cancer prevention Trial (SELECT). *JAMA* 301:39–51
- Gann PH (2009) Randomized trials of antioxidant supplementation for cancer prevention: first bias, now chance-next, cause. *JAMA* 301:102–103
- Roman B, Carta L, Martínez-González MA, Serra-Majem L (2008) Effectiveness of the Mediterranean diet in the elderly. *Clin Interv Aging* 3:97–109
- Trichopoulou A, Costacou T, Bamia C, Trichopoulos D (2003) Adherence to a Mediterranean diet and survival in a Greek population. *N Engl J Med* 348:2599–2608
- Mitrou PN, Kipnis V, Thiebaut AC et al (2007) Mediterranean dietary pattern and prediction of all-cause mortality in a US population: results from the NIH-AARP Diet and Health Study. *Arch Intern Med* 167:2461–2468
- Trichopoulou A, Costacou T, Bamia C, Trichopoulos D (2003) Adherence to a Mediterranean diet and survival in a Greek population. *N Engl J Med* 348:2599–2608
- Trichopoulou A, Vasilopoulou E, Georga K et al (2006) Traditional foods: why and how to sustain them. *Trends Food Sci Technol* 17:498–504
- Ashwell M, Lambert JP, Alles MS et al (2008) How we will produce the evidence-based EURRECA toolkit to support nutrition and food policy. *Eur J Nutr* 47[Suppl 1]:2–16
- Pijls L, Ashwell M, Lambert J (2009) EURRECA – a network of excellence to align European micronutrient recommendations. *Food Chem* 113:748–753
- Trichopoulou A, Soukara S, Vasilopoulou E (2007) Traditional foods: a science and society perspective. *Trends Food Sci Technol* 18:420–427
- Trichopoulou A, Georga K (2004) Composition tables of foods and Greek dishes, 3rd Edn. Parisianou Publications, Athens, GA
- Otten JJ, Pitz Hellwig J, Meyers LD (2006) Dietary reference intakes: the essential guide to nutrient requirements. National Academies Press, Washington, DC
- Commission of the European Communities (1993) Reports of the Scientific Committee for Food (31st series). Office for Official Publications of the European Communities, Luxembourg
- Trichopoulou A, Vasilopoulou E, Georga K (2005) Macro- and micronutrients in a traditional Greek menu. In: Elmadfa I (ed) Diet diversification and health promotion. Vol. 57. Forum of nutrition. Karger, Basel, pp 135–146
- European Parliament and Council (2007) Regulation (EC) No. 1924/2006 of the European Parliament and of the Council of 20 December 2006 on nutrition and health claims made on foods. Official Journal of the European Union OJ L 404, 30 December 2006. Corrigendum OJ L 12 18 January 2007, pp 3–18
- Winichagoon P (2008) Limitations and resolutions for dietary assessment of micronutrient intakes. *Asia Pac J Clin Nutr* 17[Suppl 1]:296–298
- Dilis V, Vasilopoulou E, Trichopoulou A (2007) The flavone, flavonol and flavan-3-ol content of the Greek traditional diet. *Food Chem* 105:812–821
- Vasilopoulou E, Georga K, Bjoerkov Joergensen M et al (2005) The antioxidant properties of Greek foods and the flavonoid content of the Mediterranean menu. *Curr Med Chem* 5:33–45
- Trichopoulou A, Vasilopoulou E, Hollman P et al (2000) Nutritional composition and flavonoid content of edible wild greens and green peas: a potential rich source of antioxidant nutrients in the Mediterranean diet. *Food Chem* 70:319–323
- Ermidou-Pollet S, Pollet S (2008) The relevance of trace element nutrition in human health. *Cell Biol Toxicol* 24:359–363