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Vitamin composition of ethnic foods commonly consumed in Europe

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Abstract

Background: Vitamin analyses are particularly important for estimating dietary intakes, determining nutritional status and regulating food labelling. Due to the increased popularity of ethnic foods, the vitamin composition of these foods is required to ensure that national food databases are up-to-date.

Objectives: The key objective of this study was to generate new and reliable data on the contents of fat-soluble vitamins, including vitamins A (all *trans*-retinol), D_3 & E (α-tocopherol) and those that are water-soluble (vitamins B_6, B_{12}, C, biotin, folate, niacin, pantothenic acid, riboflavin, and thiamin) in ethnic foods commonly consumed in Europe.

Design: Thirty commonly-consumed ethnic foods in Europe (from Belgium, France, Israel, Italy, The Netherlands, and the UK) were analysed using harmonised methodologies for identification of representative foods, sampling, data scrutiny and documentation to generate reliable data. Analyses were carried out using International standard methods.

Results: Certain vitamins were present in appreciable amounts: β-carotene in *tayer* leaves (7919μg/100g), thiamin in *frik* dry (0.24mg/100g), riboflavin in *mbinzo* worms (0.79mg/100g,) and niacin in *commercial soy patty* (17.5mg/100g). However, retinol, pantothenic acid, vitamins D and B_{12} were below detectable levels in the majority of the foods analysed.

Conclusions: The majority of the foods contained most of the water-soluble vitamins but lacked fat-soluble vitamins. However, these preliminary data represent only a small number of foods per country and so no conclusions about vitamin imbalances can be drawn. Additional data are required on a much wider range of commonly-consumed ethnic foods to make firm conclusions about adequacy of diets.

Keywords: *ethnic foods*; *vitamins*; *food composition*; *immigrant foods*

Vitamins have important nutritional, metabolic and physiological roles, and optimal intakes, through diet, are required to reduce the risk of deficiencies and associated diseases. Intake of excessive amounts of vitamins C, D and β-carotene from dietary or supplement sources may be associated with reduced risk of chronic diseases such as heart disease (1–3) and certain cancers (4, 5). Although the risk of vitamin deficiencies amongst well-fed populations is low, life-threatening risks in low-income countries are found. Thus dietary deficiency of vitamin A presents a major threat to life from night blindness and keratomalacia in both children and adults from the sub-continents of India and Africa (6), and poor immunity in Chinese children (7).

Recently, widespread vitamin D deficiency in newborns and pregnant mothers in Urban Massachusetts has been reported (8), and has also been found to be associated with an increased risk of rickets in toddlers, children and adolescents (9–12). The incidence of vitamin D deficiency is widely reported to be increasing and might be due to both inadequate dietary intakes and limited exposure to the sun due to changes in lifestyles of adults and children. The study in Urban Massachusetts also reported that skin colour was found to be a risk for vitamin D deficiency in mothers, whereas race/ethnicity was a statistically-higher risk for this deficiency in infants leading to the suggestion that the association with variable race/ethnicity may include unidentified and unmeasured confounders that have an important

bearing on infant vitamin D status but not on maternal vitamin D status (8). Water-soluble vitamins such as folate are important for reducing the risk of both neural tube defects (NTDs) (13) heart disease by lowering homocysteine levels (14), whilst vitamin B_{12} deficiency is associated with pernicious anaemia in infants (15) and elderly populations and patients with intestinal disease (16, 17).

Recent findings from the EPIC Study (18) showed gender- and region-specific differences in the intakes of retinol, β-carotene, vitamins D and E in 10 European countries together with significant heterogeneity in dietary patterns and incidence of cancer. Differences in intakes and dietary sources of vitamins such as the B vitamins (from meat) and vitamin C (from fruit and vegetables) have also been reported from this extensive investigation. However, the lack of a standardised nutrient database has been identified as a major obstacle to determining reliable nutrient intakes across Europe (19). The dietary importance of vitamins across the populations demands a greater knowledge of vitamin composition in foods, especially in cooked and ready-to-eat foods, in order that their intakes can be accurately calculated.

Vitamins are known to be affected by different processing methods, including frying, boiling, baking, grilling, and microwave cooking. Riboflavin (B_2), pyridoxine (B_6) and biotin are usually stable to domestic cooking whilst thiamin (B_1) and vitamins A, C and E, are relatively labile. For such labile compounds, the processing conditions, including duration and nature of storage, must be taken into account when determining their contents (20). This means that it is crucial that analytical data are obtained from foods *as eaten*. Because of the wide variation in techniques of production and of ingredient proportions in ethnic foods, there is an additional need to fully describe and analyse available ethnic foods by accurate methods in order to fill the gaps in national food composition data.

Present investigation

Sampling
A total of 30 commonly-consumed ethnic foods, five foods each from Belgium, France, Israel, Italy, The Netherlands and the UK, were prioritised according to set criteria including market share, popularity through sale outlets and consumption data (22). The food products analysed represented different cuisines: *North African and Maghreb* (from France); *Israel/Mediterranean–Ethiopian* (Israel); *Latin American and Asian* (Spain); *Surinamese* (The Netherlands) and *Congolese* (Belgium). Foods were divided into two categories: 1) *modified ethnic foods,* consumed by mainstream populations, which were collected from supermarkets, restaurants and takeaways, and 2) *authentic ethnic foods* (mainly consumed by ethnic

minority groups) which were either home-made or obtained from ethnic food stores. Primary samples of modified (the majority of which numbered between 3 and 12 apart from *molokhia* sauce, yellow split peas and *pamtayer* leaves which were each available as single primary sample) and authentic (six samples of each) foods were combined to make a composite sample. All the samples were prepared in edible form and stored at −20°C prior to analysis.

Analysis
The vitamins were analysed at accredited laboratories using the harmonised approaches for sampling, food description, data scrutiny and documentation developed within the EuroFIR project (21). Samples were analysed at eight accredited laboratories; CAR LAREBRON (France), Standard Institute of Israel (Israel), CEINAL (Spain), Technical University of Denmark (DTU, Denmark); Neotron (Italy), UGhent and Chemphar (Belgium) and Eurofins (UK). International standard methods for β-carotene, all *trans*-retinol, vitamins D_3 and E (α-tocopherol), and selected water-soluble vitamins (vitamins C, B_6, B_{12}, folate, and thiamine, riboflavin, niacin, biotin and pantothenic acid) were used (Table 1).

Results and discussion
The foods examined in this study were selected to generate new and reliable data for inclusion in national databases. Such data are required for a wide variety of purposes including national food consumption and nutrition surveys. New data on 12 vitamins and β-carotene in 30 ethnic foods consumed in six countries are presented, as per 100g edible portion, in Table 2a and b.

Fat soluble vitamins
Retinol, a type of vitamin A (23), which is beneficial to humans because of its crucial role in vision and bone growth (24), was present in very low levels or below the detection limit in the vast majority of foods except *rasmalai* (UK) which contained 62μg/100g. Whilst some foods contained appreciable amounts of β-carotene, *harrisa sauce* (4000μg/100g) and *tayer leaves* (7919μg/100g) were found to be excellent sources of vitamin A, representing 83% and 165% of the recommended dietary intake, respectively (based on 700 and 900μg/day recommended for ages between 14–50 year) (24). Ethnic foods such as *palak paneer* (4066μg/100g), *gajjeralla* (2324μg/100g) and *saag* (1514μg/100g) which are consumed in the UK were also rich in β-carotene (25). Vitamin D was not present in any of the foods analysed whilst vitamin E varied between 0.07μg/100g (*frik dry*, France) and 12.4μg/100g (*meloukhia sauce,* France).

Table 1. Analytical methods used for vitamin analyses in ethnic foods

Vitamin	Methods
Vitamin A (all-*trans*-retinol)	HPLC–UV (BS EN 12823-1:2000), HPLC-DAD, (IDF standard 142), HPLC (NF EN 12823-1)
â-carotene	HPLC-UV; HPLC-DAD (AOAC 45.1.03, 1995), HPLC (NF EN 12823-2)
Vitamin B_{12}	Microbiological (AOAC 960.461 and AOAC 952-20), ELISA (RIDASCREENFAST vitamin B_{12} test Art. No:R2102)
Total Folate	Microbiological (AOAC 944.12/45.2.03, 1990)), ICP_MS
Vitamin C	HPLC (J. Agric. Food Chem. 1984 32, 352–5), HPLC-FLU, (26, 27), HPLC-UV; HPLC (NF EN 14130), titrimetric (AOAC 967.21), HPLC-DAD (PNTQ1001)
Vitamin E (á-tocopherol)	HPLC (BS EN ISO 687:2001 BS 5766:2001, NF V 18-144; NF EN 12822), HPLC-FLU (AOCS Ce 8–89, revised 1990; PNTQ1012)
Vitamin D_3	HPLC-UV (BS EN 12821:2000, NEN-EN 12821, 2000), HPLC (NF EN 12821), ISO/DIS 14892, 1998)
Vitamin B_3 (Niacin)	HPLC-UV (28), based on: J AOAC 76(5) ; microbiological method
Pantothenic acid	Microbiological assay (AOAC 945.74, 1990)
Vitamin B_6	HPLC – FLU (Food Chem 1993; 48:321–324, Food Chem 1995; 52: 81–86, (29); Arr du 12/01/99, JORF du 04/02/99), HPLC (XP ENV 14164), based on: J AOAC 85(4); microbiological method
Biotin	Turbidimetric (analogue to FDA method, LST AB 266.1), microbiological (AOAC 945-74)
Thiamin (Vitamin B_1)	HPLC – FLU (BS EN 14122:2003; (30); PNTA1001; AOAC 960-46), HPLC (NF EN 14122), based on: J AOAC 76(5)
Riboflavin (Vitamin B_2)	HPLC – FLU (BS EN 14152:2003; (31); AOAC 960-46), HPLC (NF EN 14152), Based on: J AOAC 76(5)

Source: Khokhar *et al.,* 2009[22].

Water soluble vitamins

A vast majority of the foods analysed in this study contained water-soluble vitamins and, as anticipated, varied according to their composition and processing conditions.

Amongst the foods studied, thiamin was present in highest amounts in authentic *falafel* consumed in Israel (0.30mg/100g) whilst a commercial *falafel* product from Italy contained much lower levels (0.17mg/100g). *Frik* dry (0.24mg/100g, France) and *sarmale* (0.20mg/100g, Italy) contained appreciable amounts of this vitamin but most other foods contained below 0.10mg/100g. Riboflavin was present in highest amounts in *mbinzo* worms (0.79mg/100g, Belgium). Thiamin, niacin and riboflavin and their co-enzymes play a key role in metabolism of carbohydrates, protein and fat. It is suggested that an intake of 0.6mg/1000 kcal for both thiamin and riboflavin meets the needs of most healthy adults (19). The range of niacin (not found in all samples) varied between 0.05mg/100g (*harrisa sauce* and *buttermilk*, France) and 17.5mg/100g (*commercial soy patty,* Israel). Most food contained niacin except for *rasmalai* from UK. The current RDA for niacin is 16mg/day and 14mg/day for adult men and women, respectively (5, 14). 'Niacin' comprises two compounds, nicotinic acid and nicotinamide and may function in oxidative metabolism and electron transport system, and its deficiency may be associated with significant irritation and diarrhoea (6).

Of the foods in this study, only *kebab* samples from Italy and UK contained significant amounts of vitamin B_{12} (2μg/100g, compared with a recommended daily intake of 1–2 μg/day) (19). Foods analysed for folate contained only small amounts of this vitamin ranging between 0–68μg/100g in *injera* and *frik*, dry, respectively. Majority of foods analysed did not contain vitamin C, which was mainly due to heat losses because all of these foods were cooked or processed. Pantothenic acid analysis was conducted only on the five foods from France, and varied between 0.27mg/100g (*meloukhia* sauce) and 0.82mg/100g (*frik* dry), whilst biotin was found in most foods between 1.0μg/100g and 23μg/100g.

The incompleteness of published food composition data in these ethnic foods, precluded comparison of the data determined with other studies. However, the present data were determined at accredited laboratories and certified references materials (CRM) were used to ensure the validity and reliability of data. These data are fully documented and are now included in national databases in the relevant countries.

Conclusions

The foods analysed in this study represent a wide variety of food products and varied in type of ingredients to include meat-based dishes, cereal and vegetable products. This diversity resulted in significant variations in the measured vitamin contents. It is concluded that *tayer*

Table 2a. Vitamin composition of ethnic foods commonly consumed in Europe

No	Food	Vitamin composition of food per 100g edible portion												
		Retinol	β-carotene	Thiamin	Riboflavin	Vitamin B_6	Vitamin B_{12}	Folate	Niacin	Biotin	Pantothenic acid	Vitamin C	Vitamin E	Vitamin D
		μg	μg	mg	mg	mg	μg	μg	mg	μg	mg	mg	mg	μg
France														
1	Brik pastry sheet, baked	..	50	0.09	0.05	0.08	<DL	12.4	1.7	5.5	0.42	..	<DL	<DL
2	Harrisa sauce	..	4000	<DL	0.21	0.26	<DL	28.0	0.05	23.0	0.52	..	6.1	<DL
3	Buttermilk, cultured, low fat, plain	..	50	0.05	0.20	0.05	0.24	7.8	0.05	2.8	0.38	..	0.1	<DL
4	Frik, dry (51511)	..	50	0.24	0.09	0.14	<DL	68.2	0.05	6.8	0.82	..	0.1	<DL
5	Meloukhia sauce	..	83	<DL	0.09	<DL	<DL	28.4	0.05	12.3	0.27	..	12.4	<DL
Israel														
6	Falafel	<DL	82	0.30	<DL	0.20	<DL	8.8	15.9	7.1	..	1.2	3.1	<DL
7	Dark bread	100	<DL	0.18	<DL	0.10	<DL	<DL	3.7	1.0	..	2.2	0.6	<DL
8	Commercial soy patty	<DL	168	0.06	0.60	0.50	<DL	<DL	17.5	1.4	..	7.7	5.1	<DL
9	Injera	300	<DL	0.17	<DL	..	<DL	<DL	8.7	3.4	..	1.5	2.0	<DL
10	Commercial hummus	<DL	17	<DL	0.05	0.20	<DL	<DL	<DL	4.5	..	12	3.3	<DL
Italy														
21	Cantonese rice	<DL	12	0.17	0.09	0.05	..	..	1.4	<DL	..	<DL	1.3	..
22	Nachos	<DL	<DL	0.16	0.10	0.13	..	..	1.7	<DL	..	..	3.94	..
23	Falafel (Italy)	<DL	<DL	0.11	0.08	0.06	..	..	0.7	<DL	..	..	4.98	..
24	Kebab	4	<DL	0.13	0.38	0.14	2	..	1.0	<DL	..	..	0.52	..
25	Sarmale	<DL	<DL	0.20	0.08	0.05	<DL	..	2.0	<DL	..	2.59	0.13	..

.. − not determined; <DL − below detectable level.

Table 2b. Vitamin composition of ethnic foods commonly consumed in Europe

No	Food	Retinol	β-carotene	Thiamin	Riboflavin	Vitamin B$_6$	Vitamin B$_{12}$	Folate	Niacin	Biotin	Pantothenic acid	Vitamin C	Vitamin E	Vitamin D
		μg	μg	mg	mg	mg	μg	μg	mg	μg	mg	mg	mg	μg
The Netherlands														
26	Roti (chapatti)	<DL	<DL	0.06	0.04	0.09	..	13	0.7	..	..	..	6.34	..
27	Salted meat	100	..	0.01	0.12	..	..	..	..	..	..	..	..	..
28	Tayer leaves	..	7919	0.04	0.53	..	..	..	..	..	..	..	1.32	..
29	Pomtayer	<DL	513	0.03	0.07	..	..	..	..	..	..	..	..	..
30	Yellow split peas	..	<DL	0.26	0.04	..	..	..	..	..	..	..	..	..
Belgium														
31	Makayabo	<DL	..	0.03	0.31	..	..	..	..	..	..	..	..	..
32	Saka-saka	<DL	..	0.07	0.31	..	..	..	..	..	..	15	..	..
33	Chikwangue	..	..	0.06	0.04	..	..	..	..	..	..	..	..	..
34	Mbinzo worms	..		0.02	0.79							..		
35	Biteku-teku	<DL	..	<DL	0.12	..	..	..	..	..	..	<DL	..	..
United Kingdom														
36	Chicken bhuna	<DL	522	0.02	..	0.15	<DL	7	2.6	4.6	..	..	1.55	<DL
37	Lamb kebab	<DL	166	..	0.06	0.17	2	12	3.1	6.7	..	..	0.67	<DL
38	Aloo Bombay	<DL	646	0.01	0.02	<DL	..	7	0.8	..	..	<DL	1.83	..
39	Rasmalai	62	..	..	0.15	..	<DL	..	<DL	3.8	..	..	0.16	..
40	Chicken rogan josh	<DL	884	0.06	..	0.14	<DL	14	2.3	4.0	..	35	1.75	<DL

.. – not determined; <DL – below detectable level.

leaves (from Belgium) and *harrisa* sauce (from France) are excellent sources of β-carotene (containing 7919 and 4000μg/100g, respectively) and may have value for optimising intakes of vitamin A due to the lack of retinol in other ethnic foods analysed in this study.

The majority of the foods contained most of the water-soluble vitamins but lacked fat-soluble vitamins. However, only five foods were examined from each country and clearly not all the data required to make firm conclusions about the nutritional adequacy of ethnic diets or a diet containing ethnic food are included. Until more foods are analysed, it is difficult to reach a conclusion about the need, if any, for optimising vitamin intakes through, for example, dietary fortification.

Foods presented are commonly consumed by mainstream populations and ethnic minority groups suggesting that these foods would be important for their contributions towards daily intakes of some of these vitamins. Ethnic minority groups consuming ethnic foods are amongst those possessing the least purchasing power and so are unlikely to vary their diets significantly and may also be at higher risk of adverse diet-related health conditions.

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