# Mediterranean diet of Crete: foods and nutrient content

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## ABSTRACT

**Objectives** To describe the traditional diet of Crete and evaluate the nutrient composition of 3 types of diet common in Crete by means of chemical analyses of composite food samples. To compare results with dietary analyses from a nutrient database developed at the University of Crete, Greece.

**Design** Three composite diet samples were obtained based on 7-day weighed food records representing the traditional Cretan Mediterranean diet (diet A), typical diet of present-day Greek adolescents (diet B), and fasting diet of the Eastern Orthodox church (diet C). Analyses were performed chemically and using a nutrient database.

**Results** Chemical analyses provided a definitive measure, for the first time, of the nutrient composition of the complete Greek diet as it was in the early 1960s. In comparing chemical analyses with nutrient database analyses, differences greater than 15% of the analyzed value were found in all 3 diets for cholesterol and some vitamins. The differences between analyzed and calculated values in total fat and saturated fat content were less than 15% in all diets.

**Applications/conclusions** The present study provides 2 practical examples of the Mediterranean diet, which although widely publicized has rarely been analyzed chemically. Diet A has been shown to be related to the lowest rates for coronary heart disease and cancer mortality compared with the diets of the other populations of the Seven Countries study. As such, it could be recommended for health promotion and prevention of disease. Diet C contains even lower amounts of saturated fatty acids and would be excellent for patients with hypercholesterolemia. The high antioxidants in diet C probably maintain very low levels of low-density lipoprotein cholesterol. Dietary analyses of the Greek diet could be based on an operational database such as ours if further chemical analyses are performed on specific foods. These would result in improved precision of the database and possible extension into national food composition tables and a national dietary database. *J Am Diet Assoc. 2000;100:1487-1493.*

There are no national food composition tables available in Greece. Dietary analyses are usually obtained from a combination of various sources, for example, the nutrient composition of similar foods analyzed in other European countries and/or the United States. A major aim of this study was to determine the nutrient composition of 3 common types of Greek diet by chemically analyzing composite food samples based on 7-day weighed food records. A second objective was to investigate the applicability of an operational nutrient database designed at the University of Crete and adapted for inclusion of foods specific to Greece (Crete in particular) by comparing results of chemical analyses with the computed values.

Chemical analyses were conducted of 3 food composites, each corresponding to a certain type of diet observed in Crete. One diet represented the traditional Cretan diet of the 1960s, which has been of great interest because of its cardioprotective benefits as inferred from large epidemiologic studies such as the Seven Countries study (1,2). The population of Crete was found to have the best health status and the lowest morbidity and mortality rates from coronary heart disease and cancer of all 16 cohorts, including other Mediterranean populations. The 3 Italian cohorts, for example, had over twice as high 25-year mortality rates for coronary heart disease in comparison with the Cretan cohort (3). The Cretan cohort had the lowest age-adjusted, all-cause mortality rate after 20 years (4). The diet of the population of Crete was found to be the main factor related to excellent health status and lowest mortality rates (3). Also analyzed was the present-day diet of adolescents, a diet that reflects the Westernized trends that are increasingly evident in the diet of young Greeks. The third diet analyzed was that of the Greek Orthodox church during a period of fasting. The fasting period as defined by the church has been one of the main characteristics of the Cretan Mediterranean diet for the past 2,000 years. The tradition is maintained in the Greek monasteries, and many elderly Greeks still follow the fasting rules.

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**Table 1**
Foods eaten by time period of consumption for every meal in each of 3 Cretan diets[a]

| | Breakfast | Mid-morning | Lunch | Mid-afternoon | Dinner |
|---|---|---|---|---|---|
| **Monday** | | | | | |
| Diet A | *Ksinohontros*[b] rusk, orange | Pear | Broad beans, onion, salad (cucumber, tomato, purslane, olives, olive oil), whole-wheat bread, apple, red wine | Walnuts, dry figs | Boiled vegetables, potatoes, olive oil, boiled egg, melon, red wine |
| Diet B | Chocolate milk, croissant | Sweet bread | Salad (cucumber, tomato, olive oil), pork, fried potatoes, wheat bread, cola, orange | Corn snacks, chocolate | Pizza, cola, popcorn |
| Diet C | Avocado, coffee, bread,[c] sweet bread | | Squid, tomato, olives, bread[c] | | Orange |
| **Tuesday** | | | | | |
| Diet A | Rusk, cheese, apple | Orange | Snails, potatoes and vegetables, salad (tomato, cucumber, onion, olive oil), whole-wheat bread, red wine, longan | *Halva* (homemade) | Rice with spinach, yogurt, whole-wheat bread, longan |
| Diet B | Chocolate milk, toast with ham and cheese | | Pasta with beef, cheese, cola, orange | Orange nectar, sweets, chewing gum | *Souvlaki,* cola, nuts |
| Diet C | Avocado, coffee, bread[c] | | Broad beans (puree), radish, olives, orange | | |
| **Wednesday** | | | | | |
| Diet A | Doughnuts (homemade) with honey, apple, herbal tea | Pear | Chickpeas, herring, salad (tomato, cucumber, olives, olive oil), whole-wheat bread, cherries, red wine | Walnuts, figs, *raki* | Stuffed tomatoes, whole-wheat bread, salad (tomato, cucumber, onion), melon |
| Diet B | Milk, cake | Cheese pie | White bread, chicken, potatoes, carbonated drink, salad (lettuce, olive oil), butter, orange | Orange nectar | *Pasticio,* white bread, cola |
| Diet C | Coffee, *tahini*, sugar, bread[c] | Chocolate milk | *Hontros,* bread,[c] avocado, olives, orange | | |
| **Thursday** | | | | | |
| Diet A | Fresh whole milk boiled with ground wheat | Melon | Fish, broad beans (puree), oil, lemon juice, whole-wheat rusk, salad (tomato, cucumber, olives, olive oil onion), pear, red wine | *Halva* (homemade) | Lentils, salad (tomato, cucumber, olives, olive oil, onion), apple, red wine, cheese, whole-wheat bread |
| Diet B | White bread, honey, margarine | Cookies, carbonated drink | Fried eggs, fried potatoes, salad (tomatoes, cucumber, olive oil), white bread | Chocolate wafer | Hamburger, fried potatoes, cola |
| Diet C | Avocado, coffee, bread,[c] dessert | | Beans, bread,[c] olives, orange, jam | No food consumed | No food consumed |
| **Friday** | | | | | |
| Diet A | Rusk, olives, herbal, tea, apple | Apple | Beans, potatoes, whole-wheat bread, olives, orange | Walnuts, figs, *raki* | Broad beans, artichoke, olive oil, olives, whole-wheat bread, pear |
| Diet B | Evaporated milk, toasted bread, honey, margarine | Cheese pie | Salad (cucumber, tomato, olive oil), fried fish, wheat bread, cola, apple | Sandwich with cheese, ham | White bread, beer, fried egg, fried potatoes, almonds |
| Diet C | Avocado, coffee, sugar, bread[c] | | Rice with tomato, bread,[c] olives, avocado, sugar | | |
| **Saturday** | | | | | |
| Diet A | Milk and whole wheat, melon | Apple | Chicken, okra, potatoes, salad (lettuce, cucumber, olives, olive oil) | Homemade cheese, pie, honey, coffee | Boiled vegetables with olive oil, rusk, red wine, melon |
| Diet B | Evaporated milk with sugar, cereals | Carbonated drink, doughnuts | Lentils, wheat bread, cola | Banana, dessert | *Pasticio,* cheese, white bread, cola |
| Diet C | Tomato, olive oil, bread,[c] coffee, sugar, *halva* (homemade) | | Boiled vegetables (radish, spinach, chicory), olive oil, red wine, *taramosalata,* apple, bread[c] | | Pasta with soy, oil and tomatoes, bread,[c] apple, red wine |

**Table 1 (cont'd)**
Foods eaten by time period of consumption for every meal in each of 3 Cretan diets[a]

| | Breakfast | Mid-morning | Lunch | Mid-afternoon | Dinner |
|---|---|---|---|---|---|
| **Sunday** | | | | | |
| Diet A | Homemade cheese pie with honey, melon | | Rabbit, pasta, salad (tomato, cucumber, olives, olive oil, onion), rusk, wine, orange | Coffee, *halvas* | Fish, fish soup with vegetables, rusk, red wine, apple |
| Diet B | Evaporated milk with sugar, egg, white bread | White bread, honey, margarine | Beef, rice, white bread, salad (cucumber, olive oil) | Orange, dessert | Pasta (with bacon, ham, cream, eggs, cheese), white bread, cola |
| Diet C | Coffee, sugar, bread,[c] margarine | | Pasta with soy, oil and tomatoes, boiled artichokes, red wine, spinach pie, apple | | Artichokes (with olive oil, onion and lemon), bread,[c] red wine |

[a]Diet A reflects the traditional Cretan diet of the 1960s, diet B represents the diet of present-day adolescents in Crete, and diet C represents the fasting diet of the Greek Orthodox church.
[b]Greek foods: *Ksinohontros*=yogurt, wheat. *Halva* (homemade)=semolina, olive oil, sugar, walnuts; *Pasticio*=meat, margarine, tomatoes, pasta, cheese, milk, flour, eggs. *Hontros*=wheat, oil, tomato. *Taramosalata*=eggfish *(taramas)*, olive oil, bread, lemon juice, parsley.
[c]Homemade with whole-wheat flour.

## MATERIALS AND METHODS

### Samples

Three composite food samples, representing the 3 different types of diet, were prepared for chemical analysis during spring 1996 on the basis of 7-day weighed food records. Home-cooked foods were prepared according to traditional recipes and convenience foods were bought from local supermarkets or take-out stores.

The food sample representing the traditional Cretan diet (diet A) was based on a diet constructed retrospectively from diets observed in 1960 in the Cretan cohort of the Seven Countries study (1)—a 15-member subsample of which provided 7-day weighed food records—and in the 1962 study of 280 Cretan men (2) older than 45 years. There were 163 entries over the 7-day period, of which 54 were different foods or drinks. Only 1 food (brown bread) was produced industrially, 2 were fried foods, (44%) were boiled or roasted foods, and 12 (22%) were raw fruits and vegetables.

The second food sample, representing adolescents' diet (diet B), was constructed on the basis of dietary surveys conducted in the first year of secondary school in the 2 Cretan prefectures of Heraklion and Lassithi during 1994 (unpublished data from the University of Crete). A 7-day weighed food inventory was completed in such way as to be representative of the dietary pattern of a "typical 12-year-old boy." The food record contained 131 entries, which included 46 different foods or drinks. There were 21 (46%) industrially produced foods or drinks, 9 (20%) fried foods, 12 (26%) boiled or roasted foods, and 7 (15%) raw fruits and vegetables.

The fasting diet sample (diet C) was obtained from the dietary regimen at the nunnery Moni Savvathianon in Heraklion. A nun kept a 7-day, continuous, weighed food inventory during the week preceding Palm Sunday in April 1996. There were 91 entries of which 28 were different food items. There were no industrially produced foods or drinks, only 1 fried food (spinach pie), 10 (36%) boiled or roasted foods, and 4 (14%) raw foods. The nun had been given detailed instructions on how to construct the sample. A double portion of the food consumed was refrigerated and collected twice a week by the dietitian.

Details of the types of foods contributing to the 7-day weighed food record for each of the 3 diets are presented in Table 1.

Diets A and B were constructed on a daily basis by a dietitian and stored in a refrigerator. Midway through the week, the foods and drinks (except for drinking water) in each type of diet were blended together in a food mixer. The procedure was repeated for the foods in the diet during the second part of the week. Then the 2 mixtures (3-day and 4-day) were blended together for each of the 3 diets. The 3 composite samples were stored at –30°C for a 2-week period and shipped on dry ice to TNO Voeding, (Zeist, The Netherlands, a laboratory accredited under EN-45001.

### Analytical Methods

TNO Voeding conducted chemical analyses of the 3 composite food samples. Crude fat content was determined by extraction with petroleum ether with a boiling range 40 degrees Celsius to 60 degrees Celsius after hydrolysis with hydrochloric acid (5). The crude protein (total nitrogen calculated as crude protein) content was analyzed according to the Kjeldahl method using a Gerhardt apparatus, (percentage nitrogen26.25). Total carbohydrate2(starch plus sugars)was determined using the pancreatin method (6). Monosaccharides and disaccharides were determined using a high-performance liquid chromatography (HPLC) technique based on retention time and refraction index detection (7). Total dietary fiber (insoluble plus soluble) was analyzed gravimetrically. To obtain the calcium, iron, sodium, and potassium content of the composite samples, atomic absorption spectroscopy was applied to preparations made by dry using according to in-house TNO methods. Folic acid content was determined by microbiologic assay with *Lactobacillus casei.* The vitamins B-1 (thiamin), B-2 (riboflavin), and B-6 were measured by HPLC based on retention time and fluorometric detection. Vitamin B-12 content was determined using the comparative protein-binding assay. Fat composition was analyzed by means of capillary gas chromatography based on determination of fatty acid methyl esters, a method based on the Dutch standard method. Sterol composition, including the cholesterol content of the isolated fat (Weibull Stoldlt), was determined by capillary gas chromatography, based on Dutch standard procedures.

Chemical analysis output was given to a precision of 2 decimal places on the basis of 100 g of food intake. These results were converted to average daily intake values using the total weight of the food samples analyzed.

**Table 2**
Results of chemical analysis to determine energy and nutrient content (per 100 g of food) in 3 composite 7-day diet samples representing common Cretan diets[a]

| Energy and nutrient | Unit of measurement | Diet A | Diet B | Diet C |
|---|---|---|---|---|
| Energy | kcal/100 g | 104 | 138 | 142 |
| Protein | g/100 g | 4.0 | 5.0 | 4.3 |
| Total fat | g/100 g | 4.9 | 6.0 | 5.3 |
| Saturated fatty acids | g/100 g | 1.2 | 2.5 | 0.6 |
| Monounsaturated fatty acids (*cis*) | g/100 g | 2.4 | 2.0 | 3.1 |
| Polyunsaturated fatty acids (*cis*) | g/100 g | 0.8 | 0.9 | 0.6 |
| *Trans* fatty acids | g/100 g | 0.01 | 0.11 | <0.005 |
| Total carbohydrates | g/100 g | 10.9 | 16.0 | 19.6 |
| Glucose | g/100 g | 1.8 | 1.7 | 1.2 |
| Fructose | g/100 g | 1.8 | 2.6 | 1.1 |
| Saccharose | g/100 g | <0.2 | 0.5 | <0.2 |
| Maltose | g/100 g | 0.6 | 0.5 | 0.8 |
| Lactose | g/100 g | <0.2 | 0.5 | <0.2 |
| Total sugars | g/100 g | 4.2 | 5.8 | 3.1 |
| Dietary fiber | g/100 g | 2.0 | 1.0 | 2.2 |
| Cholesterol | mg/100 g | 6.6 | 13.6 | 9.8 |
| β-Sitosterol | mg/100 g | 9.8 | 8.6 | 27.5 |
| δ5-Campesterol | mg/100 g | 1.4 | 1.9 | 4.0 |
| Stigmasterol | mg/100 g | 0.8 | 0.8 | 0.8 |
| δ5-Avenesterol | mg/100 g | 2.8 | 1.3 | 2.4 |
| δ7-Stigmasterol | mg/100 g | 1.3 | 0.1 | 0.3 |
| δ7-Avenesterol | mg/100 g | 2.2 | 1.3 | 1.0 |
| Brassicasterol | mg/100 g | <0.1 | 0.1 | <0.1 |
| Calcium | mg/100 g | 46 | 41 | 26 |
| Iron | mg/100 g | 0.8 | 0.6 | 0.7 |
| Sodium | mg/100 g | 150 | 155 | 240 |
| Potassium | mg/100 g | 190 | 150 | 220 |
| Folic acid | μg/100 g | 9 | 14 | 10 |
| Vitamin B-1 | mg/100 g | 0.05 | 0.07 | 0.08 |
| Vitamin B-2 | mg/100 g | 0.05 | 0.06 | 0.05 |
| Vitamin B-6 | mg/100 g | 0.07 | 0.07 | 0.23 |
| Vitamin B-12 | μg/100 g | 0.40 | 0.14 | 0.12 |

[a]Diet A reflects the traditional Cretan diet of 1960s, diet B represents the diet of present-day adolescent in Crete, and diet C represents the fasting diet of the Greek Orthodox church.

## Operational Nutrient Database

The food database Greek Diet used to calculate dietary intakes was originally created in 1990 in the Preventive Medicine and Nutrition Clinic of the University of Crete based on tables prepared by the US Department of Agriculture (USDA). Since then, the database has been upgraded using the USDA Nutrient Database for Standard Reference (release 11, 1996 USDA Agricultural Research Service, Washington, DC). Nutrient composition of various foods has been adjusted according to the results of additional analyses. There have been regular additions of new foods, including foods specific to Greece and to Crete in particular. Twenty foods currently in the database were chemically analyzed in at TNO Voeding using the methods described. The Greek Diet database currently contains 490 foods, 100 of which are mixed foods. The entries contain a maximum of 87 nutrients (including the fatty acid clusters). For combined foods in the database, recipe calculations were made according to techniques specified by McCance and Widdowson (8) with adjustments made for weight changes where necessary.

The fatty acid content of 105 individual fat-containing Greek foods sampled during 1 year (between 1995 and 1996) were analyzed at TNO Voeding. Analyses were conducted as part of the TRANSFAIR program (9-14); details of the chemical analyses performed are provided elsewhere (15). Resulting values, together with nutrient values determined by previous analyses of Greek foods (at TNO Voeding or international USDA nutrient values, were incorporated into the operational database. Energy adjustments were made to individual foods where necessary to account for differences in total fat between chemical analyses and reference values. Adjustments were also made for saturated fat content by the addition of 6% of the total fat to the saturated fatty acids in milk and dairy products to account for the butyric acid and caproic acid groups, which were not identified in the TNO Voeding analysis (16). Individual fatty acids are presented as free fatty acids rather than as a proportion of methyl esters.

Carbohydrate values in the operational database were calculated by difference methods (100-water-protein-fat-ash). Total dietary fiber was measured in the standard reference database. In the operational database, energy, macronutrients, dietary cholesterol, and dietary fiber all have less than 1% missing values. Other missing values were phytosterol (66%), oleic and linoleic acid (32%), vitamin E (27%), vitamin B-12 and vitamin A (IU) (9%), pantothenic acid (11%), folic acid (8%) and niacin (7%). Vitamin B-6, vitamin A (RE), and thiamin all have between 0.2% and 0.6% missing values. Vitamin C and riboflavin do not have any missing values.

To compare the analyzed with the calculated values, the values presented per 100 g of food were converted using the total weight of the food sample and dividing by 7 to obtain an "average" daily value. Subsequently, the percentage difference of the calculated values from the analyzed values was obtained as follows for each nutrient: 1002(calculated value–analyzed value)/analyzed value.

## RESULTS

Dairy products, meats, and eggs did not contribute to diet C. In diet B, not only were these foods consumed, but some of the products (eg, cheese pies) were bought commercially, hence their constituents were not known (eg, type of cheese, type of butter). Diet A did not contain red meat or meat products and included a higher proportion of olive oil than the other 2 diets.

**Table 3**
Estimation of daily energy and nutrient intake in the traditional Cretan diet of the 1960s (diet A), diet of present-day Cretan adolescents (diet B), and fasting diet of Greek Orthodox nunnery (diet C) based on 7-day weighed food records and using a dietary database

| Energy and nutrient | Unit of measurement | Diet A | | Diet B | | Diet C | |
|---|---|---|---|---|---|---|---|
| | | Value | % energy | Value | % energy | Value | % energy |
| Energy | kcal | 2,633[a] | | 2,758[a] | | 1,958[a] | |
| Protein | g | 77[b] | 12 | 90[a] | 13 | 52[a] | 11 |
| Total fat | g | 123[a] | 42 | 120[a] | 39 | 74[a] | 34 |
| Saturated fatty acids | g | 25[a] | 9 | 45[a] | 15 | 13[c] | 6 |
| Monounsaturated fatty acids *(CIS)* | g | 67[c] | 23 | 45[c] | 15 | 41[a] | 19 |
| Polyunsaturated fatty acids *(CIS)* | g | 18[a] | 6 | 15[a] | 5 | 14[c] | 6 |
| *Trans* fatty acids | g | 0.8[c] | 0.3 | 2.7[a] | 0.9 | 0.3[a] | 0.1 |
| ω-6 Fatty acids | g | 9 | 3 | 11 | 4 | 8 | 4 |
| ω-3 Fatty acids | g | 0.7 | 0.2 | 0.8 | 0.3 | 0.7 | 0.3 |
| C12:0+C14:0+C16:0 | g | 16 | 5 | 27 | 9 | 6 | 3 |
| Oleic acid (C18:1 C9) | g | 57 | 19 | 34 | 11 | 36 | 17 |
| Linoleic acid (C18:2 C9,12) | g | 15 | 5 | 13 | 4 | 12 | 6 |
| Total carbohydrate | g | 294[c] | 45 | 327[b] | 48 | 280[a] | 57 |
| Dietary fiber | g | 47[a] | | 19[a] | | 36[c] | |
| Alcohol | g | 17 | | 2 | | 3 | |
| Cholesterol | mg | 123[b] | | 419[c] | | 34[b] | |
| Phytosterol | mg | 267 | | 184 | | 83 | |
| Calcium | mg | 826[b] | | 1,062[c] | | 655[c] | |
| Iron | mg | 20[a] | | 15[c] | | 20[c] | |
| Potassium | mg | 4,504[a] | | 2,748[a] | | 2,777[a] | |
| Magnesium | mg | 483 | | 295 | | 340 | |
| Phosphorus | mg | 1,322 | | 1,488 | | 782 | |
| Zinc | mg | 9 | | 11 | | 5 | |
| Folic acid | μg | 559[c] | | 284[c] | | 367[c] | |
| Vitamin A | IU | 20,404 | | 2,919 | | 12,320 | |
| Vitamin A | RE[d] | 2,192 | | 657.6 | | 1,240 | |
| Vitamin E | mg | 17 | | 12 | | 9 | |
| Vitamin C | mg | 258 | | 117 | | 107 | |
| Thiamin | mg | 2.0[c] | | 2.2[c] | | 2.3[c] | |
| Riboflavin | mg | 1.8[c] | | 2.2[c] | | 1.7[c] | |
| Niacin | mg | 18 | | 18 | | 18 | |
| Pantothenic acid | mg | 5.1 | | 5.4 | | 4.0 | |
| Vitamin B-6 | mg | 2.2[c] | | 1.8[c] | | 1.3[b] | |
| Vitamin B-12 | μg | 2.5[b] | | 3.4[c] | | 0.6[b] | |

[a]Less than 15% difference from corresponding chemically analyzed value.
[b]Greater than 15% difference from corresponding chemically analyzed value; calculated value−chemically analyzed value >0; in the case of thiamin and riboflavin, comparisons were made with the chemically determined vitamin B-1 and B-2 concentrations.
[c]Greater than 15% difference from corresponding chemically analyzed value; calculated value−chemically analyzed value <0.
[d]RE=retinol equivalents.

The breads and rusks in diet A were whole meal or wheat germ and home made, whereas in diet B the bread (white) consumed was bought commercially. Fruits, vegetables, and legumes contributed to a large extent in diets A and C.

The energy and nutrient composition of the 3 composite samples per 100 g of food obtained by direct chemical analysis is presented in Table 2. Energy content was highest in diet C, and the crude protein, crude fat, and total sugar contents were highest in diet B. The proportion of calcium was highest in diet A. Vitamin B-12 was also highest in diet A, and diet C had a higher proportion of vitamin B-6 than the other 2 diets. Diet B had the highest folic acid content. The β-sitosterol content was highest in diet C, whereas δ5-avenesterol and δ7-avenesterol were present in slightly higher proportions in diet A than in the other 2 diets.

The traditional Cretan Mediterranean diet of the 1960s, which has the lowest coronary heart disease and cancer mortality rates compared with other Mediterranean diets, can be recommended for general health promotion and disease prevention

The least differences between calculated and analyzed values occurred for energy intake, protein and fat content, and potassium content of the samples (Table 3). Differences greater than 15% were found in all 3 diet samples for total carbohydrates (although all differences were less than 17%), folic acid, calcium, and the vitamins thiamin, riboflavin, B-6, and B-12. The calculated estimates of carbohydrate and the vitamins thiamin and riboflavin were higher than the analyzed values in all 3 diets. There is, however, an inherent difference between vitamins B-1 and thiamin and between B-2 and riboflavin (analyzed vs USDA values), as there is a difference in the molecular weights, which may contribute to the large differences observed. The calculated and analyzed dietary fiber values were similar for diet samples A and B, but in sample C the calculated value was about 27% higher than the corresponding chemically analyzed value.

## DISCUSSION

The importance of the present study was not in providing evidence of differences in nutritional benefits between the particular diets analyzed, but rather in obtaining an overall picture of the Cretan diet and an indication of the types of foods that provide nutritional benefits (eg, the very low level of saturated fat in the fasting diet). Information obtained using the dietary database could not account for interindividual variation in dietary intake as it was based on a single food record. Also, in effect, a single chemical analysis was performed for each diet; thus, the possible variability in different food samples could not be estimated. Hence, no generalizations can be made about quantitative differences between the 3 types of diet.

The periodically vegetarian diet observed in Cretan monasteries (diet C) meets recommended dietary allowances for almost every nutrient (except calcium) and it is very low in saturated fat and cholesterol (Table 2). Fiber and antioxidant vitamins are high in diets A and C, which offers an explanation for the low coronary heart disease and cancer morbidity and mortality of the population of Crete. The higher fiber content observed in diet A and C samples, compared with the Diet B sample, may be explained by the high consumption of fruits, vegetables, and legumes observed in both of these diets. The low proportion of saturated fatty acids in Diet C can be explained by the lack of consumption of meats, dairy products, and eggs; the large proportion of bread consumed may account for the high energy and the high carbohydrate content determined in the chemical analysis. High cholesterol levels have been reported in chemical analyses of Eastern dishes based on shrimp, lamb, eggs, fish, and chicken (17). Our results showed cholesterol content to be highest in diet B, the diet that had the highest proportion of meat-based dishes. Although the calcium content of Diet C is low, a human intervention study has provided evidence that soluble dietary fibers such as inulin (18) may increase the absorption of calcium in human beings.

The dietary database approximated the chemical analyses reasonably well only for certain nutrients. However, only a composite was analyzed chemically, which inherently invokes a generalized view, and that was the aim of the article. The 2 methods of analysis seem to have a high degree of agreement about fat content; this finding is not surprising because about 50% of the foods in the database are based on foods whose fat content has been chemically determined in detail in Cretan foods (9-14). For foods with fat content, the selection of the closest match in the USDA database was based on fat content when there were various alternatives (eg, meats). This may further explain why other calculated macronutrients displayed greater differences from the analyzed values than fat and the fatty acid clusters. The higher estimated, than analyzed, monounsaturated fatty acid cluster in diets A and B may have occurred because in Greek foods olive oil is used to a greater extent than in USDA foods. The differences between carbohydrates analyzed chemically and database values can be explained by the difference calculation method (see Materials and Methods, Operational Dietary Database). Some differences between values from chemical analysis and database values may be due to canning, freezing, and frying of foods. For example, dietary fiber in potatoes is increased after frying as a result of the formation of resistant starch (19). Previous studies have found changes in the fatty acid profile after frying to be restricted mainly to unsaturated fatty acids (20, cited in 19). Long-term freezing is known to affect the nutrient composition of foods, for example, freezing fish has been found to decrease the percentage of total lipids and protein (21).

The largest percentage differences between analyzed and calculated values occurred in micronutrients. In the measurement of certain nutrients, individual cooking and eating practices affect results (22). In general, the vitamins in all 3 diets were estimated to be higher than the analyzed values. As indicated elsewhere (23,24), vitamin losses may occur during cooking, and such losses were not accounted for in this study. A second explanation for the differences is related to the precision of the food database. A third issue is that of missing values. The missing nutrient problem was managed in the Greek Diet database by incorporations from reliable food consumption tables, such as the food composition tables of the British Royal Society of Chemistry and Ministry of Agriculture, Fisheries and Food (8) and the TRANSFAIR database. (Constructed by TNO Voeding).

Comparisons between databases reflect, to a large extent, differences in the food composition tables from which the bases were derived. This study indicates that our Greek Diet database (based on USDA data but modified to incorporate particular Greek foods) provides relatively accurate estimates of certain nutrient intakes compared with direct chemical analyses. We believe that direct chemical analysis of all foods particular to the Greek diet, and the production of national food composition tables, would ultimately lead to creation of a database for nationwide use.

## APPLICATIONS

- The traditional Cretan Mediterranean diet of the 1960s (diet A), which has the lowest coronary heart disease and cancer mortality rates compared with other Mediterranean diets (1), can be recommended for general health promotion and disease prevention.

- The diet of the Greek Orthodox church during a period of fasting (diet C) is an excellent recommendation for patients with hypercholesterolemia. This diet is low in saturated fatty acids and high in antioxidants, which probably maintain very low levels of low-density lipoprotein cholesterol. The diet can also contribute to the prevention or treatment of obesity, which is a growing problem in Greece (25).

### References


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