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Zinc analysis of Egyptian foods and estimated daily intakes among an urban population group

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The zinc [Zn] content of 71 Egyptian foods were analyzed using flame atomic absorption spectrophotometry (AAS). Levels (mg per kg edible portion) ranged from trace amounts of 1.1 in oranges to 40 in luncheon meat. The daily Zn intake was estimated to be 8.5 mg per adult subject, bread being the major Zn contributor (36%).

The phytate concentration was chemically determined in foods of plant origin. Mean [phytate]/[Zn] molar ratios for baladi bread, stewed faba beans and composite food samples amounted to 4.2, 28.0 and 3.46, respectively. Copyright © 1996 Elsevier Science Ltd

INTRODUCTION

Interest in zinc (Zn) nutrition was aroused 30 years ago when Zn deficiency, related primarily to diet, was shown to be the cause of dwarfism and hypogonadism among adolescents from the lowest social classes of Egypt (Prasad, 1984). This interest has generated a need for the assessment and improvement of Zn food composition data. The only available data for the composition of local foods dated back to 1976 and Zn was determined by X-ray fluorescence (Waslien, 1976).

Nutritional deficiencies of Zn may arise from inadequate intakes (Waslien, 1976) and/or poor availability of dietary Zn (Kirksey *et al.*, 1992). Good sources of available dietary Zn are dairy products, meat, liver, eggs and seafoods.

Zn in whole grain cereals and in seed legumes had been reported to be less readily available due to the presence of phytic acid (myo-inositol hexaphosphate), the most potent inhibitor of Zn absorption (Bindra *et al.*, 1986). A major proportion (50–80%) of the minerals in wheat is found in the aleurone, however; this fraction also contains nearly 90% of the phytate present in the whole kernel (O'Dell *et al.*, 1972).

Phytic acid reduces Zn availability by combining with soluble Zn in the intestinal lumen to form an unabsorbable complex (Fairweather-Tait, 1988). When the phytate content of bread is reduced by fermentation, Zn absorption has been reported to increase (Navert *et al.*, 1985). Calcium (Ca) had also been blamed since the Ca–Zn–phytate complex is more insoluble than that formed by either element when combined separately with phytate. Ellis *et al.* (1987) suggested that the critical values of [phytate]/[Zn] and [phytate*Ca]/[Zn] molar ratios are >10 and >200, respectively. Staple diets having such high ratios had been suggested to be associated with increased relative risk of zinc deficiency (Cossack & Prasad, 1983; Bindra *et al.*, 1986; Morris *et al.*, 1988; Kirksey *et al.*, 1992). These influences are of importance in the evaluation of the recommended dietary allowances (RDA) of Zn.

In Egypt, investigations of the role of diet in the etiology of such deficiencies have been hindered by the lack of reliable data on the mineral content of locally grown and prepared foods in the country. It is now well realized that considerable variability in nutrient composition exists, depending upon the composition of the soils, growing and storage conditions, food processing and preparation practices and the maturity of the food at consumption (Hoover & Pelican, 1984). The present investigation has been undertaken to obtain reliable food composition data on the mineral content of locally grown and prepared Egyptian foods. This report deals with the zinc analysis of foods. The study is related to 1992 and the data were collected as part of a larger investigation for the assessment and evaluation of the nutritive value of Egyptian foods.

MATERIALS AND METHODS

Ninety-eight healthy volunteers of both sexes with mean ages of 39.9+1 and 36.1+1 years for males and females, respectively, and with respective body mass index (BMI) of 26.6 + 4.2 and 27.8 + 3.8, participated in the study. They were living in Cairo and Giza and differed in their socioeducational and socioeconomic status. All subjects were consuming self-selected diets. The survey methodology was as follows. The individual intake component of the survey consisted of a 3 day food diary. Each subject recorded in detail the exact type and quantity of each food during the 3 days in which he (or she) participated. In handling the data the food items were encoded on standardized forms and, for each food code, the units (portion size; serving; cup; teaspoon etc.) that were reported were then converted manually to weights in grams with standard conversion factors. The results of the survey on food consumption revealed that 143 individual foods had been recorded by the volunteers (Hussein *et al.*, 1995). Foods were reported in order by numbers of persons consuming them during the 3 day dietary record. For each product, the average daily consumption was calculated in grams. The foods were then classified into 16 commodity groups. Only food items that contributed by more than 10 g/kg to the total diet were considered and bulk liquids such as water and tea were not included in the Zn analysis.

Sampling plan

A variety of foods were sampled, including breads, grains, dairy products, meats and some vegetables. The foods included both complex prepared types (such as sandwiches and simple foods such as grilled maize. All food samples selected for Zn analysis were collected from the cities of Cairo and Giza, except bread samples which were collected from six other geographical regions.

Two to six major brands of each product were selected, prepared for consumption by standardized procedures and composited to yield one analytical sample.

Bread

Different bread types were analyzed; balady bread was prepared from highly extracted local or imported wheat (87% extraction) by a straight dough method with a starter consisting of previously fermented dough containing heterogeneous microorganisms (Mousa *et al.*, 1979). The fermented dough was then divided into 125g pieces, which were placed on a tray previously sprinkled with a layer of fine bran, proofed for 45 min, then they were flattened just before baking. The baking was carried out at high temperatures above 400°C, to give a flat circular loaf composed of two layers with no crumb and a fresh weight of roughly 100 g. Millions of such loaves are baked and distributed daily and the process is semi- or fully automated. It is the only subsidized bread and its specification is therefore under strict governmental regulations and it is vitally important to the majority of the urban population. Shamy bread was prepared from white-grade flour (72.5% extraction) according to the same process described above.

French bread and buns were prepared also from white flour using baker's yeast as a starter. Samples from the above-mentioned four types of bread were obtained from the retail market of Cairo and Giza. Six more bread types were collected from the countryside, where home-made bread-making still predominates. Each type of bread was characteristic of a specific geographical region and home-made bread samples were collected from Menoufiya, Dakahleya, Giza, Menya, the New Valley and Sinai. Bread samples collected from the four first geographical regions were prepared from a blend based on wheat: maize flour usually at a ratio of 3:1 with a handful of fenugreek seed flour added per 20 kg of flour mix. The fermented dough was cut into roughly 150–350 g portions (according to the locality) and each portion of dough was placed in the centre of a 12 in circular wooden board previously sprinkled with a layer of fine bran. The board was moved back and forth between the hands to shape the loaf and then baking started by throwing the dough directly in the stone oven, which was heated by dry tree shrubs or in modern aluminum ovens heated with butane gas. The fresh loaves are unleavened, flattened and circular with a diameter of roughly 35–40 cm and 5 mm thickness with good ability to roll and fold and with a shelf life of 10–20 days. Bread samples collected from the New Valley were prepared from the 87.5%-extraction wheat flour. The dough was moulded and rolled into 10×4 cm cylinders, and allowed to ferment under direct sunshine for 1–5 h according to the season. The baking was completed in ovens as described above. Bread collected from Sinai was prepared from long-extracted barley flour. The loaves were unleavened flattened circular loaves with a diameter of 35–40 cm and 5 mm thickness and were freshly prepared at least once a day.

Faba beans

The dry seeds were stewed in about twice their volume of boiled water, and simmered for 6–12 h until the beans became soft. Additives include cottonseed oil, lemon and salt. For Faba bean cakes (falafel), the decorticated dry beans were soaked in water for 12 h and the water drained off. Small amounts of garlic, onion, parsley and spices were added for flavouring. The mixture was then crushed into a thick paste. When ready, the mass was removed from the mortar and allowed to stand for some time. The paste was finally shaped into small, round pieces and deep-fried in boiling oil until the surface turns from green to a uniform brown colour. Stewed faba beans and falafel sandwiches consisting of almost 80% baladi or shami bread and about 20% stewed cooked faba beans mixed with oil, salt, spices and salad. The sandwiches of falafel usually contained 70% shami bread, 20% falafel and 10% green salad.

Preparation of other dishes were carried out by experienced nutritionists using standard procedures and traditional Egyptian cooking practices as domestically.

The weights of all the ingredients used, including water were accurately measured.

Sample preparation

The bread samples were allowed to dry in the air; whereby the vegetables and all other dishes were freeze-dried in a Heto freeze-drier to obtain better homogeneity. The fresh weight and final dry weight of edible portions of each food sample were recorded and the percentage moisture was calculated. The freeze-dried samples were transferred to Detmold, where they were ground in Titanium knives and stored in high-density polyethylene bottles, 100 ml capacity, with screw caps. Bottles were prewashed with nitric acid, rinsed with deionized water, dried and tested for contamination by leaching with 5% nitric acid. The bottles contained no metal liners that could contaminate the samples.

Zinc analysis

About 1 g samples were weighed precisely in test tubes and were kept in 2 ml concentrated nitric acid for 16 h at room temperature followed by warming at 50–70°C until effervescent and the red fumes of nitrous oxide gas ceased; finally the tubes were boiled at 150°C in a thermo block (Gebr. Liebisch, Bielefeld 14, Germany) to reduce volume by one half. After cooling, a mixture of concentrated nitric, sulfuric and 60% perchloric acids (2:0.5:0.1 ml) were added to each tube and a heating program was applied to raise the temperature from 70 up to 350°C within 42 h in a thermo block equipped with a programmable circuit. The clear wet ash was redissolved in 0.2% aqueous nitric acid for measurement of zinc on a Perkin Elmer flame atomic absorption spectophotometer [FAAS] at 213.9 nm.

ANALYTICAL INSTRUMENTATION

Ultrapure grade chemicals were used throughout. Nitric acid was purified by sub-boiling distillation in a quartz still. Perchloric acid was used without pretreatment. Water purified by ion-exchange and double distillation from glass was used wherever water was specified. A clean-air hood meeting the class 100 standard (less than 100 particles sized > μm per cubic foot) was used in the final analytical steps.

High purity zinc was stock material used for preparation of standard. Volumetric transfers were carried out using Class A volumetric pipets. A 2% (v:v) solution of nitric acid, prepared with the working standards, was used as a standard blank.

The instrumental parameters used in the analysis are given below, and the instrument was calibrated for the zinc analysis using standards containing 0.25, 0.50, 0.75 μg Zn/ml.

Instrumental parameters

Wavelength:	213.9 nm (Zn)
Spectral Band Pass:	0.2 nm (Zn)
Burner Head:	10-cm single slot, titanium construction
Spray Chamber:	standard, with glass impact bead inserted
Aspiration Rate:	6.0–9.0 ml/min
Air/C_2H_2 Ratio:	10.0 L/min (Air), 2.0 L/min (C_2H_2)
Signal Integration:	5.0 s

Quality control for zinc

Quality control was maintained as follows: Each analytical batch included three reagent blanks used to monitor contamination and estimate detection limits. Validation of the analytical techniques with each batch of samples analyzed was tested with the help of certified reference materials. The following standard reference materials were obtained from the Community Bureau of Reference (BCR); Commission of the European Communities, Brussels, the Finnish Agricultural Research Center (ARCF) and from the National Bureau of Standards (US) Standard Reference Material, Washington, U.S.A. and analyzed to check the accuracy and precision of the methods: Brown bread (no. 191) wheat flour (no. ARCF 53); potato powder (no. ARCF 16); milk powder (no. ARCF 206) and animal muscle (no. ARCF 96) and certified diet (NBS diet).

Calculation

The mean absorbance produced by the standards (corrected for the standard blank) was plotted vs the concentration of the analyte in the sample to produce an external calibration curve. The concentration of the analyte in the sample was calculated from the following equation: $[M] = (C \times V)/SW$; where $[M]$ is the concentration (μg/ml) of zinc in original sample, C is the concentration of zinc in the analytical sample as calculated from standard curve in units of μg/ml, V is the volume of the analytical sample in units of ml and SW is the weight of the sample employed in units of grams.

Phytic acid determination

This was carried out in selected foods of plant origin according to the method of Wheeler & Farrel (1971). The finely ground food samples were blended with 3% trichloroacetic acid (TCA) at a ratio of 1:25 (w/v), and the homogenate was shaken for 3 h at a temperature of 60°C in a shaking water bath (Davies & Reid, 1979). After centrifugation, the phytate was precipitated in a 10 ml aliquot by adding 4 ml of freshly prepared 0.9% ferric chloride solution dissolved in 3% TCA. The ferric phytate precipitate was washed repeatedly with 3%

TCA to get rid of the excess ferric ions. The phytate was dissolved in hot 3.2 N nitric acid and iron was determined colorimetrically by the thiocyanate method. The iron concentration was calculated from a standard curve using ferric chloride standards. The phytate phosphorus was calculated from the iron results assuming an iron: phosphate molecular ratio of 4:6. The phytate concentration was calculated assuming six phosphorus atoms ($6\times32=192$ parts of phosphorus) per phytic acid molecule (mol. wt = 583). The method of standard addition of authentic phytic acid as internal standard to check for % recovery was used throughout the whole procedure and each sample was analysed in triplicate.

Assessments of dietary Zn intake

Mean Zn composition data analyzed in the present work were combined with consumption data obtained from our food consumption survey (Hussein *et al.*, 1995) to compile a core food which supplied the great majority of Zn in the Egyptian diet. Estimations of zinc intake were based on the intake in grams of each food composite and its zinc concentration. The total zinc consumed by our study group was estimated by the weighed sum of Zn in all servings of all foods reported.

The percent contribution provided by a particular food is then given by $\frac{\text{Zinc provided by food}}{\text{Zinc provided by all foods}} \times 100$; estimated by

$$\frac{\sum_{j=198} d_{ij} \sum_{k=0S_{ij}} \mathrm{Zn_{ijk}} \times W_j}{\sum_{j=198} \sum_{i=171} d_{ij} \sum_{k=0S_{ij}} \mathrm{Zn_{ijk}} \times W_j} \times 100$$

where i = food items, 1, 2,..., 71; j = persons, 1,2,..., 98; k = servings of that food item to that person, 0, 1, 2..., S_{ij} = number of servings of ith food consumed by jth person; $dij = 1$ if jth person consumed ith food, = 0 otherwise; Zn_{ijk} = amount of Zn contained in serving k of food i to individual j; W_j = sample weight for that individual. This equation thus represents a statement about the percent contributed by each food to the population's total consumption of Zn (Block *et al.*, 1985).

RESULTS AND DISCUSSION

Faba beans provide high phytate content in the Egyptian diets. Baladi bread and stewed faba beans had mean [phytate]/[Zn] molar ratios of 4.2 and 28, respectively (Table 2). A respective molar ratio of 3.46 was found in the composite food sample; this figure coincides with the figure of 3.3 reported for a regular hospital diet in the USA (Morris *et al.*, 1988) and is quite below the critical level of 10, which had been reported to affect the bioavailability of dietary zinc (Ellis *et al.*, 1987).

Reinholdt *et al.*, 1981 suggested that access to mills producing flour of lower extraction rate would largely eliminate zinc deficiency. Other studies with man (McCance & Widdowson, 1942; Sandstrom *et al.*, 1980) do not support this hypothesis. McCance & Widdowson (1942) studied the effect on zinc balance in man with bread made of 69% and 92% extraction flour, and dietary zinc intake ranging between 5 and 22 mg a day. The authors reported no negative effect of the 92% extraction flour on zinc balance. Further evidence is provided by Sandstrom *et al.* (1980), who used a radionuclide technique and reported comparable Zn absorption from bread made of whole wheat flour containing 22 ppm and from white bread made of 72% extraction flour having a Zn content of 7 ppm. The frequently consumed foods in Egyptian diets were collected into 12 food groups. Table 3 presents the estimated mean, minimum and maximum daily intake [g/d] of different food groups among the study groups and major Zn contributors in the diet. Bread (36% of total dietary Zn), animal proteins (33.2%) and vegetables (15.7%) contributed most to the total dietary daily Zn intake among our study subjects. This compares with only a 3.2% Zn contribution from legumes. The estimated figure for daily Zn intake amounted to 8.54 mg/d.

The total zinc intakes for our study subjects are below the mean levels of 11.4 and 10.31 mg/day reported recently for Egyptian men and nonpregnant/nonlactating females from the village of Kalama, respectively (Kirksey *et al.*, 1992). According to the same authors respective available zinc intakes were 2.24 and 2.03 mg/day. These workers used FAO food composition tables for the Near East as well as other reference tables.

The estimated mean Zn of 8.5 mg/d reported in the present study is, however, not dissimilar from those reported in other studies. A daily Zn estimate of 8.11 mg/d had been reported for women participating in NHANES II (Murphy & Calloway, 1986), though the zinc content of typical mixed diets of North American adults has been reported to furnish between 10 and 15 mg/day (Pennington, 1987). Excellent agreements were obtained between analyzed Zn for USDIET-1 and calculated values (Iyengar *et al.*, 1987).

In another study, a group of vegans had a Zn intake of 7.9 mg/d compared with 12.7 mg/d for non-vegetarians (Freeland-Graves *et al.*, 1980). The lower estimates for zinc intakes among our study subjects could be partially attributed to the fact that foods commonly consumed in Egypt, i.e. cereals, vegetable, and animal products including eggs, meats and fishes are lower in their zinc content (Table 1) than those reported in the food composition tables (Murphy *et al.*, 1975; Muller *et al.*, 1992). When the content of analyzed foods reported here and literature values were compared, the largest discrepancies between analyzed and literature values were found in milk, eggs and meats. The Zn contents of analyzed yoghurt tended to be much lower (26.6 mg/kg dry weight) than those reported elsewhere (42.8–49.9,

Table 1. Zinc contents (mg/kg) in selected food commodities

Food description		Moisture	Zinc Content			
			mg/kg.DM		mg/kg as eaten	
	N	%	Mean	SE	Mean	SE
Cereals						
1. Bread, wheat flattened; 85% extr.	14	24.6	19.2	0.99	14.5	0.75
2. Bread, wheat flattened; 72% extr.	2	26.3	11.2	1.7	8.23	1.25
3. Bread, wheat rolls; 72% extr.	3	24.8	8.36	1.23	6.28	0.92
4. Bread, wheat buns; 72% extr.	2	21.4	11.4	0.16	8.98	0.13
5. Bread, home made; sun-fermented (NV)	4	35.8	22.7	0	14.6	0
6. Bread, home made; wheat-maize (3:1)	2	22.2	22.0	6.51	17.1	5.06
7. Bread, home made; barley (Sinai)	5	31.0	14.4	2.33	9.96	1.61
8. Macaroni; fine; home made; raw	2	7.0	9.89	0.19	9.20	0.18
9. Macaroni raw; 2 brands	2	8.0	7.54	0.42	6.94	0.39
10. Macaroni, cooked	2	48.8	14.3	0.38	7.33	0.19
11. Macaroni, lasagne	2	52.5	3.85	0.42	1.83	0.20
12. Pizza	2	33.5	14.4	0.1	9.59	0.07
13. Bars; Rings; Zwieback	3	11.5	8.02	0.72	7.10	0.64
14. Puffpaste filled, ground beef	3	29.3	14.7	3.17	10.4	2.24
15. Wheat flour	2	14.4	7.91	0.26	6.77	0.24
16. Rice; raw	2	8.0	10.2	0.41	9.35	0.38
17. Rice; cooked	5	58.8	8.35	0.79	3.44	0.32
18. Fattah; bread–rice; beef broth	2	65.0	12.5	0.25	3.44	0.07
19. Maize; grilled	3	35.7	18.5	.0	4.39	0
20. Starch, maize	2	12.1	0.60	0.0	0.53	0.0
21. Keks; raisin; 3 brands	6	27.8	8.32	.62	6.0	0.45
22. Oriental puff paste; heavy syrup	2	21.1	23.2	16.0	18.3	12.6
23. Kunafa; heavy syrup	3	26.5	6.74	0.89	4.95	0.65
24. Puff paste; home made; sugar	3	6.1	8.87	0.35	8.32	0.33
25. Basbousa; heavy syrup	3	13.0	6.52	0.35	5.67	0.30
26. Date bars; pressed date, wheat	6	16.6	10.7	0.41	8.91	0.34
27. Waffles filled; 2 brands	4	8.0	7.55	3.77	6.95	3.47
28. Kahk; sugar cookies seasoning;	2	6.0	7.23	0.08	6.80	0.07
29. Sugar; cane	2	0.2	2.86	0.0	2.85	0
Tubers						
30. Potatoes; cooked	5	69.4	25.1	0.86	7.66	0.26
31. Potatoes; chips	3	40.0	10.2	1.03	6.09	0.62
32. Potatoes, chips; in sandwich	2	55.0	14.7	0	6.60	0
33. Taro; cooked + leaf celery	2	73.4	23.1	2.23	6.14	0.59
34. Sweet potatoes	2	85.4	14.0	0	2.04	0
Vegetables						
35. Cabbage leaves; stuffed with rice	2	67.9	21.5	1.03	6.91	0.33
36. Carrots; fresh	5	89.4	26.0	0.35	2.75	0.04
37. Cauliflower; cooked; tomatoes	2	65.0	42.0	0.20	14.7	0.04
38. Eggplant; cooked	2	80.1	28.1	0.06	5.59	0.05
39. Eggplant; stuffed with rice	2	62.3	12.2	0.33	4.58	0.12
40. Eggplant sandwich	2	60.4	17.3	0.55	6.8	0.22
41. Okra; cooked; tomatoes	2	72.0	39.5	0.12	11.1	0.03
42. Onions	2	90.7	42.6	0.15	3.96	0.01
43. Vegetable soup	2	88.5	32.0	0.19	3.68	0.02
Leafy vegetables						
44. Jew mallow; chicken	3	85.0	39.2	1.00	5.88	0.15
45. Spinach; tomatoes	5	76.5	41.9	0.05	14.4	0.02
46. Green mallow; beef broth	3	80.6	25.9	0.0	5.01	0
47. Lettuce; fresh	5	94.9	29.8	1.45	1.52	0.07
48. Raddish; white, fresh	3	90.3	47.8	0.51	4.63	0.05
49. Garden rocket; *Eruca sativa*	3	89.7	50.9	0.99	5.24	0.10
Fruits						
50. Kantalop	2	90.9	10.7	0.84	0.97	0.08
51. Oranges	10	84.8	7.20	0.44	1.09	0.07
52. Peaches	2	82.5	9.30	0.13	1.63	0.05
Legumes						
53. Faba beans, stewed	8	72.3	33.7	2.46	5.94	0.43
54. Faba bean, stewed, sandwich	2	60.3	15.5	6.14	10.2	0.06
55. Faba bean cake, sandwich	2	50.0	19.2	8.23	9.64	0.11
56. Beans; white; raw	2	7.8	31.6	0.6	29.1	0.55
57. Beans; white; tomatoes	2	69.5	27.6	1.52	8.42	0.46

contd

Table 1—*contd.*

Food description	N	Moisture %	Zinc Content mg/kg.DM Mean	SE	mg/kg as eaten Mean	SE
58. Peas; tomatoes	5	72.3	26.3	0	7.28	0
59. Cowpeas; cooked; tomatoes	3	75.1	48.1	0.75	12.0	0.19
Meats and Fish						
60. Eggs; chicken; boiled	6	74.3	47.9	4.03	12.3	1.03
61. Chicken leg; boiled	3	45.1	60.1	1.05	33.0	0.58
62. Chicken broth	3	93.8	39.2	1.85	2.51	0.12
63. Meat; bovine; raw	3	55.7	58.1	0.52	10.5	0.09
64. Luncheon meat	2	46.1	74.3	3.3	40.1	1.78
65. Sausage; stuffed; bulgur	3	77.6	19.1	0.86	4.28	0.19
66. Fish, freshwater	3	54.3	18.7	2.95	7.78	1.23
67. Fish, fried	3	54.8	22.1	0	8.58	0
Milk and Dairy Products						
68. Milk, yoghurt	3	56.7	53.9	4.09	30.5	2.32
70. Cheese; white defatted	3	70.4	39.7	0.44	11.7	0.13
71. Cheese; salty	2	72.7	34.4	0.52	9.39	0.14
NBS diet (Analyzed)*			15.6			
NBS diet Certified*			17.0			

Table 2. Analysed phytate and zinc molar ratios in selected Egyptian foods

	Estimated daily intake (grams) As eaten	Dry matter	Zinc Content in mg/kg	Phytic acid Dry matter	[Phytate][Zn] Molar ratio
Bread, baladi; 85% extr.	202	152	19.2	710	4.17
Bread; shami	14.4	10.8	9.90	89	0.95
Pasta + other wheat products	57.2	42.9	14.3	89	1.02
Rice; cooked	198	81.6	8.35	0	0
Potatoes + other tubers	52.5	16.1	24.9	0	0
Leafy vegetables	31.5	3.6	41.9	490	1.39
Vegetables, others; cooked	32.2	13.9	28.1	1310	4.25
Peas; cooked	34.0	5.4	26.3	140	0.62
Faba bean, stewed	44.6	11.9	33.7	9410	28.0
Fruits	18.4	2.6	6.90	68	1.10
Dairy products	108	34.7	40.1	0	0
Eggs	7.0	1.8	48.3	0	0
Meats	46.5	10.4	58.2	0	0
Fishes	19.9	8.3	20.0	0	0
Composite diet					3.46

Table 3. Major contributors of Zn in the Egyptian diet

Food description	Estimated intake ($N = 98$) food type (g/day) Mean	SE	Min.	Max.	Zinc intake of total mg/day	
Bread, baladi; 85% extr.	224	10.8	33.3	457	3.08	36.2
Other cereals	39	4.3	10.0	92.9	0.260	3.1
Biscuits, cakes	16	0.4	7.9	38.0	0.125	1.5
Rice cooked	191	13.4	13.4	383	0.657	7.7
Sugar; sweets	64	3.4	9.4	209	0.148	1.7
Tubers	36	8.4	9.9	71.8	0.249	2.9
Vegetables	238	21.6	43.6	351	0.835	9.8
Legumes	44	3.1	18.5	96.1	0.306	3.6
Fruits	29	3.6	8.4	49.8	0.021	0.3
Milks; dairy products	110	4.0	26.8	281	2.025	23.8
Eggs;	17	3.0	8.3	42.7	0.209	2.5
Fishes	20	3.1	7.9	31.9	0.156	1.8
Total					8.54	

Kumpulainen, 1988; 37.9, Muller *et al.*, 1992). Hence, Zn intakes, would be overestimated by our study subjects by approximately 2–4 mg/day using the current food composition database based on the German Federal Food Code (Hussein *et al.*, 1995).

Recommended dietary allowances for Zn have been set at a level of 15 mg for adult males and 12 mg for adult non-pregnant and non-lactating women, based on an average requirement of 2.5 mg/day for absorbed Zn and an absorption efficiency of 20%, to meet the needs of all healthy persons, including those who consume diets with low Zn bioavailability (RDA, 1989) National Academy of Science.

Cossack & Prasad (1983) concluded from their studies that 15 mg dietary Zn may not be sufficient to meet the daily requirement for adults if soya-bean protein is the major source of protein. The substitution of meat with soya-bean products, usually high in phytate, has been reported to create problems with Zn nutrition (Sandstrom *et al.*, 1980).

The data presented here cover a broad range of foodsconsumed in Egypt and emphasize the importance of using food composition data derived from locally grown, prepared and cooked foodstuffs for calculating nutrient intakes from food consumption survey data.

Further investigations are warranted to assess the bioavailability of Zn from Egyptian diets in human balance biological experiments.

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