Phytate Content of Some Popular Kuwaiti Foods

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ABSTRACT

The phytate content in some foodstuffs popular in Kuwait, including bread, rice, and legumes, was determined by an ion-exchange procedure. The phytate content in certain bread types and uncooked rice, peas, and beans is presented. The cooking of selected foodstuffs resulted in reduction of phytate content. The phytate content in different varieties of bread ranged from 0 to 0.2%. The brown arabic bread, made up of whole wheat, showed 72% more phytic acid content than did the white arabic bread. The phytate content in different varieties of uncooked rice ranged between 0.05 and 0.22%. When rice was cooked after steeping in excess water and then the excess water discarded, the phytic acid concentration decreased 82%. When the rice was cooked without removal of excess water, phytic acid concentration decreased only 31%. Green peas and beans contained 0.38 and 0.15% phytic acid, respectively. When they were cooked in excess water and then the excess water discarded after cooking, the phytic acid content decreased 58 and 65%, respectively.

Phytate (myo-inositol hexakis dihydrogen phosphate) is a naturally occurring, organic substance with chelating properties that forms strong complexes with some nutrient mineral cations, reducing their bioavailability (Oberleas et al 1977). Measurement of the phytate content of plant foods is important because human deficiencies in calcium, zinc, and iron are associated with high dietary phytate intake (Davies 1979).

The present study deals with the determination of phytic acid content in different cereal varieties and legumes that are popular in Kuwait. The effect of cooking on phytic acid was also studied.

MATERIALS AND METHODS

Sample Collection and Preparation

Samples of bread, rice, sweet peas, and green beans were purchased from Kuwaiti markets. The samples of different varieties of bread and rice, sweet peas, and green beans were dried to constant weight at 100°C and ground in a sample mill (Cyclone, Tecator & Co., Bromma, Sweden). These ground samples were then used for determination of phytate content.

Two different procedures were followed for cooking rice samples. The first procedure involved steeping 50 g of each rice sample in 100 ml of distilled water for 1 hr at room temperature. The excess water was removed by filtration. Then the rice was boiled in 200 ml of water for 20 min. The excess water was removed and mixed with water removed after steeping. The cooked rice samples were blended and dried at 100°C overnight and ground. The phytic acid was determined in both the dried samples and the excess water removed after steeping and cooking.

The second procedure is the procedure usually followed for cooking rice in the Middle East. Rice samples (50 g) were boiled in 100 ml of distilled water (1:2, w/w), so that no excess water remained. After cooking, the rice samples were blended, dried at 100°C overnight, ground, and used for phytate content determination.

The first cooking procedure described above was also used for cooking sweet peas and green beans.

Phytate Extraction and Determination

Five grams of each dried sample was extracted for 1 hr at room temperature with 100 ml of 0.667*N* HCl. The extract was filtered under vacuum and kept at 4°C. This extract was subjected to phytic acid determination.

The phytate content in the sample extracts was determined by the ion-exchange method of Latta and Erskin (1980), with some modification. The acid filtrate was diluted (1:5, v/v) with distilled water. Diluted filtrate (10 ml) was passed at the rate of 0.3 ml/min through a column, 0.7 × 15 cm, packed with 0.5 g of 50–100 mesh Dowex 1 × 8 anion exchange resin (Fluka AG CH 9470, Buchs, Switzerland). The column was washed with 15 ml of distilled water and then with 10 ml of 0.1*M* NaCl to elute the inorganic phosphates. Phytic acid in the eluate was determined by colorimetric method using Wade's reagent. Wade's reagent (1 ml [0.03% $FeCl_3$·6, H_2O, and 0.3% sulfosalicylic acid in distilled water]) was added to 3-ml aliquots of sample or sodium phytate standards and mixed on a vortex mixer for 5 sec. Absorbance was determined at 500 nm against a water blank using a spectrophotometer (Spectronic 21, Baush and Lomb). Four independent measurements of phytic acid were conducted with each sample of bread, rice, and legume. Data thus obtained were subjected to statistical analysis following standard procedures (Jeffery et al 1989) for analytical processes.

RESULTS AND DISCUSSION

Table I shows the phytic acid content of different types of bread. Iranian bread showed the highest concentration of phytic acid (0.2%). Toasted white bread contained no detectable phytate. This difference may be due to a lower phytate content in white flour than in whole wheat flour, or it may be due to the longer fermentation time (Ranhotra et al 1974). Brown Arabic bread, made up of whole wheat, showed at least 72% more phytic acid content than did Arabic white bread. Lolas et al (1976) also reported a high phytic acid level in food containing wheat bran or whole wheat.

The phytic acid content in different varieties of uncooked rice was between 0.05 and 0.22%, as presented in Table II. In the Middle East, rice is usually cooked in a minimal amount of water (1:2, w/w), so that no excess water remains. When rice was cooked in this manner, no reduction in phytate content of Basmati or Peshawar rice varieties was obtained. American and Egyptian rice lost 31 and 4.2% of phytate content, respectively, when cooked under these conditions. American rice showed the highest reduction (31%) in phytate content, so it was selected for further studies. When American rice was cooked after steeping in minimal amount of water, and the excess water was removed by decantation after cooking, about 82% phytate content of rice was extracted

TABLE I
Phytate Content in Bread Varieties

Bread Type	Kuwaiti Name	Phytate Content, mg/100 g[a] Dry Basis	Fresh Basis
Iranian	Khobz Irani	300 ± 2.06	210
Pita, brown	Khobz Arabi asmar	233 ± 2.06	169
Pita, white	Khobz Arabi abyad	135 ± 1.92	95
Toast, brown	Toast asmar	270 ± 2.06	153
Toast, white	Toast abyad	...	...
SEM		± 1.43	

[a] Mean ± SD of four independent determinations calculated only for dry samples.

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TABLE II
Phytate Content in Rice Varieties and Effect of Cooking on Phytic Acid Level

Rice Variety	Kuwaiti Name	Phytate Content[a] (mg/100 g)		Reduction in Phytate Content by Cooking (%)
		Dry	Fresh	
Basmati, uncooked	Eish basmati	60 ± 1.62	53	
Basmati, cooked		59 ± 1.29	17	0
American, uncooked	Eish Americani	248 ± 1.4	216	
American, cooked without excess water		170 ± 1.47	51	31
American, cooked with excess water		46 ± 1.14	...	82
Excess water removed after steeping and cooking[b]		200 ± 1.83	...	...
Egyptian, uncooked	Eish Masri	165 ± 1.4	144	
Egyptian, cooked		158 ± 1.47	47	4.2
Peshawar, uncooked	Eish Peshawar	90 ± 1.35	79	
Peshawar, cooked		90 ± 1.28	27	0
SEM		± 1.00		

[a] Means ± SD of four independent determinations calculated for dry samples only.
[b] Phytic acid content is amount in the total volume of excess water removed after steeping and cooking.

TABLE III
Phytate Content in Sweet Peas and Green Beans and Percent Removal of Phytic Acid After Cooking

Food	Kuwaiti Name	Phytic Content (mg/100 g, dry basis)[a]	Percent Reduction in Phytic Acid After Cooking
Sweet peas, uncooked	Bajela Khadra	384 ± 1.80	
Sweet peas, cooked		158 ± 1.78	58
Excess water[b]		220 ± 2.95	
Green beans, uncooked	Fasolia Khadra	150 ± 1.83	
Green beans, cooked		52 ± 1.41	65
Excess water		95 ± 2.95	
SEM		± 1.21	

[a] Means of ± SD of four independent determinations.
[b] Phytic acid concentration in total volume of excess water removed after steeping and cooking.

(Table II). These results are in accordance with those reported by Toma and Tabekhia (1979). They reported a 75% decrease in phytic acid level after cooking the rice for 10 min in deionized water. This variation in level of phytic acid may be due to the difference in cooking procedures. Complete phytic acid content remains in the cooked rice when excess cooking water is not drained from the rice.

Raw peas and beans showed 0.38 and 0.15% phytic acid, respectively (Table III). Cooking reduced phytate level 59% in peas and 65% in beans. This was confirmed by measuring phytic acid in excess water removed after steeping and cooking. Excess water contained 220 and 95 mg of phytic acid per 100 g of dried peas and beans, respectively (Table III). Manan et al (1987) reported about 78% reduction in phytic acid content after steeping peas in excess water and discarding excess water after cooking. This decrease in phytic acid is due to leaching of soluble phytates into cooking water, which is discarded with decanted water. Several workers (De Boland et al 1975 and Reddy et al 1978) have reported a reduction in phytate content after cooking.

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