NOTE

Retention of Selected B Vitamins in Cooked Pasta Products[1]

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ABSTRACT

Four brands of each of spaghetti, egg noodles, and macaroni were purchased in four U.S. cities and were analyzed for six B vitamins including the three enrichment vitamins, thiamin, riboflavin, and niacin. For the majority of products, the content of the enrichment vitamins in the dry products met the prescribed standards. A good portion, one-half to three-fourths, of the vitamins was retained following cooking. One serving of the cooked products (= 5.75 oz) provided up to 30% of the recommended daily dietary allowance of thiamin, 11% of riboflavin, 19% of niacin, 4% of folic acid, 3% of pantothenic acid, and 2% of vitamin B_6.

Cereal Chem. 62(6):476-477

Most pasta products commercially produced in the United States are enriched. Enrichment adds three B vitamins (thiamin, riboflavin, and niacin), iron, and, sometimes, the optional nutrient calcium (CFR 1980). Because cooking water is often discarded, cooked pastas may retain only a fraction of the B vitamins present in the dry products. This study examines the extent of retention in three widely consumed pasta products. Four major U.S. cities were sampled to assess possible regional differences in the content and retention of vitamins analyzed.

MATERIALS AND METHODS

In 1982, four major brands each of spaghetti, egg noodles, and macaroni (all product labels indicated enrichment) were purchased in Chicago, Dallas, Los Angeles, and Washington, DC. Six pounds of each brand from Chicago and three pounds of each brand from each of the other three cities were obtained, thoroughly mixed, and divided into three equal portions. One portion was cooked following the package instructions, but without adding fat or salt. The cooking instructions invariably implied "cook to desired tenderness." This took, in some cases, up to 14 minutes. Only one cooking trial was performed for each brand. This cooked portion and an uncooked portion were then freeze-dried, finely ground, and analyzed for six B vitamins. The third portion was used to measure pasta yield and volume (in a measuring cylinder) after cooking. For Chicago, each brand of a product was analyzed individually. For the other cities, all brands of a product were composited on an equal dry matter basis following cooking (where applicable), freeze-drying, and grinding. These composite samples were then analyzed for vitamin contents.

Standard AACC (1983) methods were used to determine thiamin (86-80) and riboflavin (86-70) fluorometrically and niacin (86-50) by the cyanogen bromide method. Folic acid, pantothenic acid, and vitamin B_6 (total) were determined microbiologically using *Lactobacillus casei* (ATCC no. 7469), *Lactobacillus plantarum* (ATCC no. 8014), and *Saccharomyces carlsbergenis* (ATCC no. 9080), respectively, as the test organisms. Microbiological determinations were based on several published methods, each used in part or modified to obtain reproducible results. All microbiological assays involved autoclaving the samples, proper enzyme treatment (chicken pancreas conjugase for folic acid and alkaline phosphatase plus pigeon liver conjugase for pantothenic acid), preparation of assay and standard series, inoculation, incubation, and spectrophotometric reading of turbidity. Culture media were obtained from Difco Laboratories, Detroit, MI. True vitamin retention (TVR) in the cooked products was calculated by the method of Murphy et al (1975) based on the equation:

$$\text{TVR (\%)} = \frac{\text{Vitamin content per g of cooked pasta} \times \text{g of pasta after cooking}}{\text{Vitamin content per g of uncooked pasta} \times \text{g of pasta before cooking}} \times 100.$$

RESULTS AND DISCUSSION

The content of B vitamins in the pasta products and the extent of their retention following cooking are summarized in Table I. These figures represent "true" retentions (Murphy et al 1975) because the loss of solids during cooking was considered in the calculations.

All pasta products tested were labeled as enriched products. The average values for Chicago and for all cities met the vitamin enrichment standards (CFR 1980). Primarily because these standards provide a range of acceptable values, brand-to-brand differences in the content of enrichment vitamins were appreciable in many cases, however. Contents of the other three B vitamins also differed among brands (Table I). Of these vitamins, pantothenic acid consistently averaged highest in noodle products, presumably because they contain egg solids, and vitamin B_6 was consistently lowest in spaghetti.

The percentage vitamin retention following cooking differed appreciably from brand to brand and also from product to product; a few retention values exceeded 90% of the amounts in dry products (Table I). In spite of this and the fact that only one cooking trial was performed for each brand, the Chicago and all-cities average retention values provide a meaningful insight into the magnitude of cooking losses and retentions. For the enrichment vitamins, retentions averaged, as found earlier (Ranhotra et al 1983), somewhat over 50%. True retentions of the other three vitamins averaged 50% or better. Although for some products the retentions tended to be higher for the nonenrichment than the enrichment vitamins, these studies are not detailed enough to suggest that naturally occurring B vitamins are better retained than the added (enrichment) vitamins. Such an inference is further confounded because the retention of folic acid in noodle products from Dallas and macaroni products from Washington, DC, exceeded 100% (Table I). The folic acid methodology was extensively tested, but perhaps it still remains less sensitive than chemical or fluorometric methods to determine vitamins in some products.

In conclusion, whereas a good portion of the vitamins analyzed was lost during cooking, cooked pastas remain a significant source of the three enrichment vitamins. Calculations show that one

[1]Presented at the AACC 70th Annual Meeting, Orlando, FL, September 1985. Studies were supported in part by a grant (59-3198-2-43) from CNC/HNIS/USDA, Hyattsville, MD 20782.
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TABLE I
The Content and Retention of B Vitamins in Pasta Products Obtained from Major U.S. Cities

Vitamin and Product	Content (mg/100 gm dry product)					Retention (%, in cooked product)				
	Dallas	Los Angeles	Washington, DC	Chicago[a]	All Cities[b]	Dallas	Los Angeles	Washington, DC	Chicago[a]	All Cities[b]
Thiamin[c]										
Spaghetti	1.40	0.94	1.05	1.12 ± 0.13	1.13 ± 0.20	50	57	56	52 ± 12	54 ± 3
Noodles	1.15	0.90	1.23	0.93 ± 0.20	1.05 ± 0.16	90	47	50	45 ± 3	58 ± 21
Macaroni	0.81	0.85	1.03	1.09 ± 0.17	0.95 ± 0.14	63	63	50	50 ± 10	57 ± 8
Riboflavin[c]										
Spaghetti	0.37	0.35	0.50	0.44 ± 0.04	0.42 ± 0.07	59	60	46	59 ± 12	56 ± 7
Noodles	0.65	0.37	0.48	0.37 ± 0.08	0.47 ± 0.13	51	53	59	52 ± 4	54 ± 4
Macaroni	0.42	0.32	0.45	0.45 ± 0.18	0.41 ± 0.06	69	59	63	63 ± 6	63 ± 4
Niacin[c]										
Spaghetti	7.47	7.65	8.67	8.50 ± 1.75	8.07 ± 0.60	71	61	56	52 ± 8	60 ± 8
Noodles	11.27	7.44	9.85	7.47 ± 1.00	9.01 ± 1.88	53	61	63	55 ± 5	58 ± 5
Macaroni	8.14	7.52	9.10	8.75 ± 1.55	8.38 ± 0.70	74	63	65	58 ± 12	65 ± 7
Folic acid										
Spaghetti	0.025	0.013	0.031	0.025 ± 0.002	0.024 ± 0.008	87	54	88	87 ± 13	79 ± 17
Noodles	0.021	0.025	0.037	0.021 ± 0.001	0.026 ± 0.008	NC[d]	79	99	58 ± 2	79 ± 21
Macaroni	0.022	0.017	0.023	0.013 ± 0.002	0.019 ± 0.005	81	83	NC[d]	66 ± 15	77 ± 9
Pantothenic acid										
Spaghetti	0.538	0.382	0.576	0.421 ± 0.003	0.474 ± 0.097	58	82	72	80 ± 5	73 ± 11
Noodles	0.689	0.579	0.972	0.807 ± 0.050	0.762 ± 0.168	68	40	50	64 ± 11	56 ± 13
Macaroni	0.464	0.359	0.491	0.426 ± 0.026	0.435 ± 0.057	69	68	60	50 ± 10	62 ± 9
Vitamin B_6										
Spaghetti	0.086	0.082	0.083	0.085 ± 0.009	0.084 ± 0.002	84	77	76	50 ± 6	72 ± 15
Noodles	0.155	0.150	0.151	0.140 ± 0.021	0.149 ± 0.006	61	39	48	65 ± 3	53 ± 12
Macaroni	0.130	0.132	0.105	0.148 ± 0.008	0.129 ± 0.018	53	53	83	33 ± 9	56 ± 21

[a]Average (± SD) values of the four brands.
[b]Average (± SD) values of the four-cities averages.
[c]Ranges for standards of enrichment are: thiamin = 0.88–1.10, riboflavin = 0.37–0.48, and niacin = 5.95–7.49 mg/100 gm dry product.
[d]Not considered (NC) because retentions exceeded 100%.

serving, 5.75 oz of cooked product (National Pasta Association 1984), would provide 24–30% of thiamin, 9–11% of riboflavin, 16–19% of niacin, 3–4% of folic acid, 2–3% of pantothenic acid, and about 2% of vitamin B_6 towards our daily need expressed as U.S. Recommended Daily Allowance (NNC 1975). Value ranges reflect the differences in vitamin contents of the three pasta products tested.

LITERATURE CITED

AMERICAN ASSOCIATION OF CEREAL CHEMISTS. 1983. Approved Methods of the AACC. Method 86-50 and 86-70, revised October 1981; Method 86-80, revised October 1982. The Association: St. Paul, MN.

COMMITTEE ON FEDERAL REGULATIONS. 1980. Code of Federal Regulations. U.S. Government Printing Office, Washington, DC.

MURPHY, E. W., CRINER, P. E., and GRAY, B. C. 1975. Comparisons of methods for calculating retentions of nutrients in cooked foods. J. Agric. Food Chem. 23:1153.

NATIONAL NUTRITION CONSORTIUM. 1975. Nutrition Labeling—How it Can Work for You. National Nutrition Consortium: Bethesda, MD.

NATIONAL PASTA ASSOCIATION. 1984. The Nutrient Profile of Pasta. National Pasta Assoc.: Arlington, VA.

RANHOTRA, G. S., GELROTH, J. A., NOVAK, F. A., and BOCK, M. A. 1983. Losses of enrichment vitamins during the cooking of pasta products. Nutr. Rep. Int. 28:423.

[Received March 5, 1985. Revision received June 24, 1985. Accepted June 28, 1985.]