NOTE ON VITAMINS AND MINERALS OF WILD RICE

E. W. SWAIN, H. L. WANG, and C. W. HESSELTINE, Northern Regional Research Center, Agricultural Research Service, U.S. Department of Agriculture, Peoria, IL 61604

Cereal Chem. 55(3): 412-414

Wild rice (*Zizania aquatica*) is an aquatic wild grass which grows in Canada and the Great Lakes area of the U.S. The plant is usually found growing in shallow, slow-moving bodies of water such as lakes or man-made "paddies" which have been dredged out of the flat lands. Newly harvested wild rice grains are covered with a hull and are moist and flexible. Before marketing, the grain must be dried and the hulls removed. The processing entails placing the freshly harvested rice in long narrow piles in the open for 10–14 days to cure or naturally ferment. After curing, the rice is parched and the hull removed, after which the kernel is scarified to minimize the soaking time for kitchen preparation of the rice (1).

Many minerals are essential for normal metabolic functions and are required components in a balanced diet. Calcium, phosphorus, potassium, sodium, and magnesium are required in fairly large quantities and iron, copper, manganese, and zinc in micro quantities. The ability of plants to assimilate minerals may vary with regard to variety and environmental conditions. The present study was undertaken to determine vitamin and the mineral content of wild rice with regard to variety and location.

MATERIALS AND METHODS

The wild rice samples were collected from three processing plants and represented four varieties (K-2, Johnson, Lake, and Shattering) harvested from various locations in northern Minnesota.

Ashing

All mineral determinations were made on wet ashed samples. Ten grams of whole grain rice were ashed in 40 ml of concentrated nitric acid (2).

Phosphorus determinations were made by the colorimetric molybdenum method (3). All other minerals were determined by flame atomic absorption on a Varian Techtron AA120 Atomic Absorption Spectrophotometer with an acetylene-air combustion mixture. Single element hollow cathode lamps were used at the recommended current ratings. Duplicate samples were used for each of the 34 samples. Proteins were determined by the micro-Kjeldahl method. Thiamin, riboflavin, niacin, and free folates were determined by microbiological assay (4). All vitamin assays were run at three levels and in duplicate for each sample.

RESULTS AND DISCUSSION

The range of various vitamins and minerals and their overall mean are given in Table I. The analytical data for the 34 wild rice samples were examined

0009-0352/78/000045$03.00/0

statistically with regard to variety, location, and processor. The statistical analysis indicated significant variation between means for moisture. In the Gully-Trail area, K-2 variety had a mean of 10.71% moisture; Johnson, 6.87%; Lake, 6.85%; and Shattering, 5.71%. In the Aitkin area, K-2 variety had a mean of 9.83%; Johnson, 7.43%; Lake, 9.36%; and Shattering, 7.38%. However, the moisture content was fairly uniform in samples collected from the same processor. Protein content (N × 6.25) showed no significant variation with respect to variety or location. Wild rice has a higher protein content than polished white rice, 6.7%, or corn, 8.9%, and compares with oats, 14.2%, or whole wheat, 12.3% (5).

The results of the vitamin assays showed that thiamin and free folates varied more than did niacin and riboflavin; however, there is no significant variation with respect to variety and location.

The thiamin content of wild rice averaged 0.1 mg/100 g of rice which is lower than many cereals (wheat, 0.52; oats, 0.60; and corn, 0.37) but is comparable to polished white rice, 0.07. The riboflavin and niacin content of wild rice is higher than the above cereals. Riboflavin is 0.27 mg/100 g wild rice as compared to 0.12 for wheat, 0.14 for oats, 0.12 for corn, and 0.03 for polished white rice. Niacin is 6.9 mg/100 g wild rice as compared to 4.3 for wheat; 1.0 for oats; 2.2 for corn; and 1.6 for polished white rice (5).

The thiamin and riboflavin content of wild rice in this study was lower than that reported by Nelson and Palmer (6). In addition to different methods used in the thiamin assay (microbiological *vs.* chemical), the difference could be due to the processors' curing, parching, and scarification techniques. The Indians processed wild rice without the two-week curing step. Also, the parching

TABLE I
Range of Various Vitamins and Minerals and Their Overall Mean

	Range	Overall Mean	Variation Between Processor, Variety, Location	Std. Dev. Between Samples
Moisture, %	5.70–12.17	7.91	Sig. (0.05)	1.40
Protein, % (N × 6.25)	13.25–18.06	15.22	n.s.	1.16
B_1, mg/100 g	0.02– 0.25	0.10	n.s.	0.07
B_2, mg/100 g	0.2 – 0.4	0.27	n.s.	0.05
Free folates, mg/100 g	0.01– 0.08	0.04	n.s.	0.02
Niacin, mg/100 g	4.6 –10.3	6.98	n.s.	1.05
P, g/100 g	0.41– 0.54	0.46	n.s.	0.03
Mg, g/100 g	0.14– 0.20	0.18	n.s.	0.05
K, g/100 g	0.36– 0.59	0.45	n.s.	0.05
Fe, mg/100 g	1.2 – 5.1	1.94	n.s.	0.67
Zn, mg/100 g	4.0 –12.1	6.25	n.s.	2.03
Cu, mg/100 g	0.18– 1.51	0.52	n.s.	0.39
Ca, mg/100 g	11.0 –25.0	16.18	n.s.	4.05
Mn, mg/100 g	1.1 – 1.8	1.36	n.s.	0.17
Cd, ppm	0.05– 0.58	0.13	Sig. (0.01)	0.04
Pb, ppm	0.11– 0.39	0.22	n.s.	0.15

temperature and the degree of scarification could result in a corresponding loss of other B vitamins (7).

With respect to variety and location, the statistical analysis showed a significant variation between means for cadmium. In the Gully-Trail area, K-2 variety had a mean of 0.06 ppm; Johnson, 0.07 ppm; Lake, 0.07 ppm; and Shattering, 0.35 ppm. In the Aitkin area, K-2 variety had a mean of 0.23 ppm; Johnson, 0.06 ppm; Lake, 0.28 ppm; and Shattering, 0.20 ppm. The analysis showed no correlation of the other minerals; however, the iron content of many of the samples from an area in the vicinity of the Mesabi Iron Range was higher than samples from other areas of collection. Among the individual samples, zinc, lead, and copper showed a wider range than any of the others. Zinc and lead ranged from 1× to 3× and copper ranged from 1× to 8×.

The determination of heavy metals in biological material has recently gained importance. Wild rice has more than twice the zinc content of corn (1) and wheat (8). Copper in wild rice is much higher than in corn (0.19 mg/100 g) and about the same as wheat (0.5 mg/100 g). The mean for cadmium is within the range of corn, 0.035–0.15 ppm, and about the same as for wheat. Lead content is about the same as for corn and less than half that of wheat.

Acknowledgments

Appreciation is expressed to W. F. Kwolek (Biometrician, USDA, North Central Region, ARS, NRRC, Peoria, IL 61604) for the statistical analysis; and to W. J. Garcia and L. T. Black for their technical advice.

Literature Cited

1. GOEL, M. C., GADDI, B. L., MARTIN, H., STUIBER, D. A., LUND, D. B., LINDSAY, R. C., and BRICKBAUER, E. Microbiology of raw and processed wild rice. J. Milk Food Technol. 33(12): 571 (1970).
2. GARCIA, W. J., BLESSIN, C. W., and INGLETT, G. E. Heavy metals in whole kernel dent corn by atomic absorption. Cereal Chem. 51: 788 (1974).
3. AMERICAN ASSOCIATION OF CEREAL CHEMISTS. Approved methods of the AACC (Sec. 63.16) (6th ed.). The Association: St. Paul, MN (1957).
4. ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS. Official Methods of Analysis (12th ed.). The Association: Washington, D.C.
5. ANDERSON, R. A. Wild rice: Nutritional review. Cereal Chem. 53(6): 949 (1976).
6. NELSON, J. W., and PALMER, L. S. The thiamin, riboflavin, nicotinic acid, and panthothenic acid contents of wild rice (*Zizania aquatica*). Cereal Chem. 19(5): 539 (1942).
7. CAPEN, R. G., and LeCLERC, J. A. Wild rice and its chemical composition. J. Agric. Res. 77(3): 65 (1948).
8. ZOOK, E. G., GREENE, F. E., and MORRIS, E. R. Nutrient composition of selected wheats and wheat products. VI. Distribution of manganese, copper, nickel, zinc, magnesium, lead, tin, cadmium, chromium, and selenium as determined by atomic absorption spectroscopy and colorimetry. Cereal Chem. 47: 720 (1970).

[Received August 15, 1977. Accepted November 18, 1977]