WILD RICE: NUTRITIONAL REVIEW[1]

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ABSTRACT

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The increasing conversion of wild rice to a domestic state holds much promise of making this crop one of increasing economic importance. Nutritionally, wild rice has several attributes that set it aside from many other cereals. Wild rice has a higher protein content than most cereals. Also, for a cereal, it has an adequate balance of the essential amino acids. These and other nutritional contributions of wild rice should become better known and properly used.

Wild rice (*Zizania aquatica*), a grass indigenous to North America, grows extensively in shallow lakes and sluggish streams from southern Canada to the Gulf of Mexico and from the Atlantic Ocean to the Rocky Mountains. Historically, explorers coming into the territories of the Northern Lake States found this aquatic grain, which was new to them and which proved to be the staple food of a large part of the native population. Without wild rice, it is doubtful that the Indians in the region could have survived. Wild rice was harvested from the lakes in early fall by boating to the rice stands and beating the mature kernels from the head with a stick. The procedure was repeated every few days until all the rice was collected. Rice seeds that dropped in the water would become the crop for the following year. The green rice was cured by spreading it in the sun for several days, by laying it on racks beneath which fires and smoke would provide the curing heat, or by drying or parching in a large kettle over a

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[2]The mention of firm names or trade products does not imply that they are endorsed or recommended by the U.S. Department of Agriculture over other firms or similar products not mentioned.

slow fire. After crude threshing to remove hulls, the finished rice was ready for storage. Wild rice served as the staple food of the early Indians, and was cooked and eaten much as it is today.

Natural stands of wild rice are harvested today in much this same manner. State laws in Minnesota require that all rice taken from public waters be harvested by the old Indian methods during certain hours, and all pickers and buyers are licensed by the State. However, today's wild rice is processed by more modern methods.

In the mid-sixties, enterprising farmers in northern Minnesota began growing wild rice under controlled conditions in paddies, much like those for regular white rice culture and production. The early paddies were seeded with wild rice collected from the lakes; today, plant breeders are breeding desirable growing characteristics into seed to obtain a uniform-maturing, nonshattering, and disease-resistant stock. In 1973, about 5 million lb of green rice was harvested from 20,000 acres. Lake rice production that year was about 1 million lb. The paddies are farmed using modern techniques and equipment.

Wild rice, whether from the paddies or the lakes, is harvested at 40 to 50% moisture content. The so-called processing of wild rice involves placing the rice in windrows on the ground for "curing." This time period will vary from 7 to 14 days, depending on the maturity of the seeds. The rice is turned daily and watered to keep it from heating. During the cure, the rice darkens and some desirable flavor characteristics appear to develop. Also, it is claimed that curing loosens the hull from the kernel—perhaps by solubilizing the cementing layer which holds the hull tightly to the seed.

After the rice is cured, it is placed in parching drums where a combination of steaming, drying, and roasting or parching takes place under controlled conditions. This operation, in addition to drying the rice, also helps develop kernel flavor, color, and texture. The dried rice is dehulled, slightly polished or scarified to scratch the seed coat, sized, and packaged.

Certainly as native a crop to the United States as corn, wild rice is recognized primarily today as a delicacy or a gourmet food. Used more for its distinctive flavor in a variety of exotic dishes, wild rice in our time is not recognized for some highly desirable nutritional properties that it possesses. Obviously, these properties were important to the early settlers because cultivated agricultural crops came some generations later.

The literature contains limited information on wild rice and its nutritive properties. Considerable work is being carried out in many research areas, including breeding, plant pathology, entomology, microbiology, composition, and processing. Improvements in seed and in cultural and processing practices will surely increase production of wild rice and its availability to the consuming public.

Proximate Composition

Wild rice resembles the common cereals in many respects. The composition of wild rice is compared with regular rice, hard red winter wheat (bread wheat), corn, and oats in Table I. Wild rice has a higher protein content than any of the selected grains, except oats. Fat content of processed wild rice is relatively low compared to the other cereals. Polished white rice is lower in fat because bran and germ are removed during polishing. Except for polished white rice, ash

values for wild rice are essentially comparable to other grains. Wild rice contains about the same quantity of crude fiber as brown rice and oats, but half that of wheat and corn. Total carbohydrate content of wild rice is slightly less than that of regular rice, but somewhat greater than those of the other cereals listed. As far as basic composition is concerned, every indication points to wild rice as an excellent food, comparable in nutritive value to common cereals used today.

Protein

As described earlier, wild rice today is harvested both from natural stands in lakes and rivers and from cultivated paddies. Workers at the University of Minnesota (4) have reported preliminary data on the distribution of amino acids in the protein of four samples of wild rice (Table II). Little variation was noted

TABLE I
Proximate Composition of Wild Rice and Other Selected Cereal Products[a]

Component %	Wild Rice	Brown Rice	Polished White Rice	Oats	Hard Red Winter Wheat	Corn
Moisture	7.9–11.2	12.0	12.0	8.3	12.5	13.8
Protein	12.4–15.0	7.5	6.7	14.2	12.3	8.9
Fat	0.5–0.8	1.9	0.4	7.4	1.8	3.9
Ash	1.2–1.4	1.2	0.5	1.9	1.7	1.2
Crude fiber	0.6–1.1	0.9	0.3	1.2	2.3	2.0
Total carbohydrate	72.3–75.3	77.4	80.4	68.2	71.7	72.2

[a]Source: references 1–3.

TABLE II
Amino Acids of Dehulled Wild Rice (% of Protein)[a]

Amino Acid	Wild Rice				Average
	Lake, Processed	Cultivated, Unprocessed	Cultivated, Processed	Cultivated, Processed	
Alanine	6.1	6.0	6.1	6.4	6.2
Arginine	8.4	7.9	8.3	8.1	8.2
Aspartic acid	10.5	10.2	10.6	10.7	10.5
Cystine	0	0	0.5	0.6	0.3
Glutamic acid	19.1	18.5	19.7	19.8	19.3
Glycine	5.1	4.7	4.9	4.8	4.9
Histidine	2.9	2.7	2.8	2.8	2.8
Isoleucine	4.7	4.3	4.5	4.3	4.4
Leucine	7.5	7.2	7.3	7.5	7.4
Lysine	4.6	4.8	4.4	4.4	4.6
Methionine	2.8	2.9	3.3	3.1	3.0
Phenylalanine	5.1	4.9	5.2	5.2	5.1
Proline	4.4	4.3	3.7	3.2	3.9
Serine	5.0	5.6	5.3	5.9	5.4
Threonine	3.3	3.1	3.1	3.1	3.2
Tyrosine	3.7	4.1	4.1	4.1	4.0
Valine	6.8	8.8	6.4	6.1	7.0
Protein, %	13.9	12.5	12.8	12.0	...

[a]Source: reference 4.

among the samples of processed lake rice and processed and unprocessed cultivated rice. Acceptable levels of lysine and methionine are present in wild rice. Indeed, a comparison of the essential amino acids of wild rice with those of other grains (Table III) indicates that lysine content of wild rice exceeds that of white rice, oats, and wheat. The lysine value of 4.6% of protein present in wild rice is about the same as is usually found in whole-grain high-lysine corn (6). The sulfur amino acid content of wild rice is about the same as white rice and oats, but somewhat greater than that found in wheat.

With respect to essential amino acid composition, wild rice compares favorably with the FAO Provisional Pattern (5). With the exception of lysine and threonine, the amount of each of the other essential acids of wild rice approximately equals or exceeds the Pattern.

Workers at the University of Wisconsin have studied amino acid distribution in the protein of wild rice of different strains grown at several locations (7,8). They noted that while protein content of different wild rices varied somewhat from location to location, distribution of essential amino acids in the wild rice proteins remained substantially the same.

Nutritionally, the protein of wild rice appears to equal that of oat groats and to be considerably better than wheat. Robbins *et al.* (9) used SLTM values (sum of lysine, threonine, and methionine contents) to establish an indication of nutritional quality for oat protein. Similar calculations by the Wisconsin workers for wild rice samples showed an SLTM value from 10.5 to 11.1, which is slightly higher than that for oat groats, 10.0, and much higher than the 7.3 value for whole wheat.

Carbohydrates

Carbohydrates of wild rice total about 75% (Table I). This total includes starch, sugars, and all other carbohydrate substances. The sugar content of natural or raw wild rice ranges from 1.8 to 2.7%, and that of processed rice averages about 1%. Also, from 2 to 3% pentosans are present (2). Starch content varies from 60 to 65% (9). The caloric value for wild rice is 353 cal/100 g; most cereal grains range at about that level.

TABLE III
Percentage of Essential Amino Acids in Wild Rice and Other Cereals (% of Protein)[a]

Amino Acid	Wild Rice	Polished White Rice	Oats	Wheat	FAO Pattern
Isoleucine	4.4	4.6	4.0	3.5	4.0
Leucine	7.4	8.0	8.3	6.8	7.0
Lysine	4.6	3.5	4.2	2.4	5.5
Methionine and cystine	3.3	2.9[b]	3.1	2.2	3.5
Phenylalanine and tyrosine	9.1	10.1	9.9	8.0	6.0
Threonine	3.2	3.5	3.2	2.4	4.0
Valine	7.0	6.5	5.8	4.4	5.0

[a]Source: references 4 and 5.
[b]Methionine only.

Lipids

Because the fat content of wild rice is quite low, approximately 1% by hexane extraction, it contributes little to the nutritive spectrum of wild rice. However, in analyzing the hexane extract, the Wisconsin workers (7,8) learned that wild rice lipid is unique when compared with white rice, wheat, and oats, because it contains a rather high level of linolenic acid (30%). The fatty acid composition of wild rice is compared to several cereals in Table IV. Further, the data in Table IV show that linoleic and linolenic acids make up more than 65% of the total fatty acid of the hexane-extracted lipid of wild rice. Because these acids are highly susceptible to oxidation, they are probably responsible for development of rancid odors in wild rice stored for a long time. Since linoleic acid is one fatty acid known to be essential for man, the high level of this acid in wild rice surely contributes to the nutritional quality of this food.

Minerals

Mineral composition of wild rice is compared with several other grains in Table V. With the exception of calcium, wild rice contains more of the common elements than brown rice or polished white rice. This condition would, of course, be expected in white rice because much of the mineral matter is present in the bran, which is polished off during processing. Because wild rice kernel is scarified or scratched during processing to enhance its cooking properties, the possibility exists that essential minerals are reduced. According to the Wisconsin workers,

TABLE IV
Fatty Acid Composition of Hexane Extracts of Wild Rice and Other Cereals (% of Total Fatty Acids)[a]

Fatty Acid	Wild Rice	Brown Rice	White Rice	Oat Groats	Wheat
Palmitic (16:0)	14.5	20.4	33.8	16.2	24.5
Stearic (18:0)	1.1	1.6	2.7	1.8	1.0
Oleic (18:1)	15.9	41.3	43.3	41.2	11.5
Linoleic (18:2)	37.7	34.5	18.0	38.8	56.3
Linolenic (18.3)	30.0	1.0	0.6	1.9	3.7

[a]Source: references 7, 8, 10, 11, and 12.

TABLE V
Minerals in Wild Rice and Other Cereals (mg/100 g)[a]

Mineral	Wild Rice	Brown Rice	Polished White Rice	Oats	Hard Red Winter Wheat	Corn
Calcium	17–22	32	24	53	46	22
Iron	4.2	1.6	0.8	4.5	3.4	2.1
Magnesium	80–161	...	28	144	160	147
Potassium	55–344	214	92	352	370	284
Phosphorus	298–400	221	94	405	354	268
Zinc	3.3–6.5	...	1.3	3.4	3.4	2.1

[a]Source: references 1, 2, 13, and 14.

TABLE VI
Vitamin Content of Wild Rice and Other Cereals[a]

Vitamin	Wild Rice	Brown Rice	Polished White Rice	Oats	Hard Red Winter Wheat	Corn
Vitamin A, I.U.	0	0	0	0	0	490
Thiamine, mg/100 g	0.45	0.34	0.07	0.60	0.52	0.37
Riboflavin, mg/100 g	0.63	0.05	0.03	0.14	0.12	0.12
Niacin, mg/100 g	6.2	4.7	1.6	1.0	4.3	2.2
Vitamin C, mg/100 g	0	0	0	0	0	0

[a]Source: references 1 and 15.

scarification of wild rice does not appear to have a detrimental effect on mineral composition as does the polishing of white rice (7,8).

The mineral composition of wild rice compares favorably with that of the common cereals—oats, wheat, and corn.

Vitamins

Like most cereals, wild rice contains no vitamin A or C (Table VI). It is, however, an excellent source of the B vitamins—thiamine, riboflavin, and niacin. Wild rice compares favorably with oats, hard wheat, and corn in thiamine content, and it is considerably richer in riboflavin than these grains. It also appears to be a good source of niacin, containing somewhat more than the listed cereals and white rice.

CONCLUSIONS

Wild rice, like most cereals, is not a complete food. It does, however, have some desirable nutritional attributes. The protein content of wild rice is relatively high for a cereal, and it contains more lysine and methionine than most common cereals. Wild rice is a good source of the B vitamins—thiamine, riboflavin, and niacin—and contains common minerals in amounts comparable to those in oats, wheat, and corn.

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