A NOTE ON SILICON IN RICE ENDOSPERM

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Appreciable quantities of silicon have been reported in rice bran, lesser amounts in germ and brown rice, and small amounts in milled rice (1, 2). In the analysis of calcium in milled rice and particularly in high-protein flours from the outer portions of the kernel, we obtained insoluble material (probably silica) which interfered with the determinations, making it necessary to modify the method (3). Silicon has since been determined in these samples and the values are presented here.

MATERIALS AND METHODS

The six varieties of rice studied—two long-grain, Belle Patna and Bluebonnet 50; two medium-grain, Calrose and Saturn; and two short-grain, Caloro and Colusa—have been described previously (4). Four fractions of each lot of commercially milled rice were obtained by passing the rice three times through a rice polishing machine, *i.e.*, first-, second-, and third-pass flours from the outer layers of the kernels and the residual kernel after the third pass. Only the flour that passed through a 40-mesh screen was analyzed.

A suitable weight of material, 60 to 70 g for the original and residual kernels and from 3 to 35 g for the flours, was pre-ashed if necessary, using an infrared heater, and then ashed at 600° C for 18 hr. Silica was determined by the AOAC method for plant materials using digestion with acid only (5) and calculated to silicon using a factor of 0.4674. Except for the original and residual kernels, each value represents the average of at least three replicates.

RESULTS AND DISCUSSION

Silicon content of the original and residual kernels averaged 46 (13 to 100) and 4 (0.9 to 5.8) mg per 100 g, respectively (Table I). The content of the residual kernels averaged 8% of that of the original milled rices. As was found with other mineral elements, values decreased from the periphery to the center of the kernel (3). There was more than a thousand-fold difference between the highest value, 1,768 mg per 100 g, for the first-pass flour of Belle Patna, and the lowest value, 0.9 mg, for the residual kernel of Colusa.

Concentrations in the first-pass flours of the two long-grain rices were nearly 20 times that of the original kernels; for the medium- and short-grain rices, from 5 to 10 times. The second- and third-pass flours of Belle Patna had concentrations 11 and 8 times that of the original kernels; the other five varieties, 2 to 9 and 1 to 2 times, respectively. The magnitude of these ratios is similar to that for magnesium but variation among lots is greater (3). Very little silicon was present in the residual kernel of any of the varieties.

The flours through 40-mesh from the first milling pass, which made up about 2% of the original rice, accounted for about 25% of the silicon in the original rice while the residual kernel, about 88% of the original rice, accounted for only 8%.

TABLE I
Silicon Content of Fractions of Overmilled White Rice

Variety	Whole Kernel	Flour through 40-Mesh Screen			Residual Kernel after Third Pass
		First pass	Second pass	Third pass	
		mg per 100 g, dry basis			
Belle Patna	100.0	1768	1114	764	5.3
Bluebonnet 50	55.6	1076	287	126	5.8
Calrose	46.7	455	85	29	3.4
Saturn	27.5	219	76	21	4.7
Caloro	36.3	195	324	44	3.6
Colusa	12.7	142	52	10	0.9
		% of Total Ash			
Average	7.4	10.1	8.4	4.9	1.3
Std. Dev.	±3.4	±7.6	±6.7	±5.6	±0.7

In Belle Patna, the three flours from 6% of the original rice accounted for 80% and the residual kernel for 5% of the silicon in the original rice.

Considerable differences among the lots are apparent. Except for the residual kernel, Belle Patna had the highest values among the six varieties. Similar trends were found for iron, calcium, and magnesium but not for phosphorus, sodium, or potassium (3). Belle Patna had eight times as much silicon in the original rice as did Colusa. The two long-grain varieties, Belle Patna and Bluebonnet 50, had the highest values; Colusa, a short-grain, the lowest. Because we started with commercially milled rice, the amount of outer endosperm removed is not known and no doubt varies among the lots. Whether differences are due to variation in the amount of bran and outer endosperm removed from the milled rice or are characteristic of the variety, culture, or geographic source cannot be determined from these data.

The silicon was not only higher in concentration in the flours from the first and second milling passes, it also made up a higher percentage of the total ash, 10 and 8%, compared with the ash of the original rices, 7% (Table I). In the residual kernel, silicon composed only 1% of the total ash. Thus, in the composition of the total ash of the original rice and the outer flours, except for Colusa, silicon is the third most abundant mineral, following phosphorus and potassium.

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