Iron and vitamin C content of commonly consumed foods in Vietnam

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The iron and vitamin C content of water spinach and rice samples from three sites in Vietnam were chemically analysed. The iron content of home-milled rice from Nghe An was higher than the iron content of machine-milled rice from Thai Binh and Hanoi. In addition, the iron content of cooked rice was lower than that of uncooked rice as iron was removed during the washing and rinsing of the rice prior to cooking. Cooked rice that was washed and rinsed less thoroughly had a higher iron content. The iron content of water spinach from different locations was very similar, although white water spinach had a much higher vitamin C content than red water spinach.

Key words: iron, vitamin C, rice, water spinach, Convolvulaceae, Vietnam, nutritional anaemia.
with the absorption of an iron standard solution to determine concentration of iron. The amount of iron in the original sample was then calculated.

**Vitamin C content analysis**
A water spinach sample of known weight was finely chopped, mixed with metaphosphoric acid and then centrifuged. The supernatant was titrated until clear with 2,6-dichlorophenol–indophenol (Association of Official Analytical Chemists; 14th ed. 1984 43.064), and vitamin C content was calculated based on titration of a standard solution. Duplicate samples were tested in parallel. Efficiency of recovery was calculated by adding a known amount of standard vitamin C solution to a food sample, and then comparing recovery of vitamin C in that sample with expected recovery based on duplicate samples from the same location. Samples from Hanoi were tested in parallel with the samples purchased in the provinces.

Loss of vitamin C was estimated by repeating the analysis of the samples from Hanoi after 2 days, and calculating the percentage loss of vitamin C after 2 days. Values used for comparison are the estimated vitamin C content on the day of cutting.

**Dry weight analysis**
A known quantity of fresh sample was dried at 100–102°C for 16 h and then weighed. Drying was repeated until a constant mass was achieved after 1 hour of additional drying. The end weight is the dry weight.

**Results**

**Water spinach**
The water spinach samples were of two different varieties, white and red (Fig. 1). At the two sites in Nghe An the samples were of the white strain, while in Thai Binh the samples were of the red strain. The samples in Nghe An were of the variety that is cultivated in dry fields, whereas the variety from Thai Binh was cultivated in wet fields. Samples of the appropriate type were also purchased in Hanoi so that a comparison could be made between content in Hanoi and content in other regions.

**Iron**
The highest iron content was found in the samples of white spinach from Nghe An and the red spinach from Hanoi, but none of the values were statistically different from the others.

**Vitamin C**
The highest vitamin C content was found in the samples of white water spinach from Hanoi and Nghe An. The vitamin C content of white water spinach samples was significantly greater than the vitamin C content of red water spinach samples from all locations.

**Rice**
**Iron**
The iron content of home-milled rice from Nghe An was higher than the iron content of machine-milled rice from Thai Binh and Hanoi (Fig. 2). The difference was not statistically significant due to the large variation in samples of rice from Nghe An.

The iron content of unwashed rice in Hanoi was higher than the iron content of washed rice. Unfortunately, only one sample of unwashed rice was analysed, and thus the significance of the difference could not be determined.
Discussion
The greater vitamin C content in white water spinach is of interest because it may increase the bioavailability of iron in the water spinach. Ascorbic acid is known to be a strong promoter of non-heme iron absorption. However, the low overall level of vitamin C in the water spinach means that it is unlikely that water spinach would have had much effect on enhancing iron absorption. Ballot et al. found that fruits with ascorbic acid contents similar to the levels found in water spinach in this study had no significant effect on the iron absorption from a rice-based meal.\(^2\)

The rice in Nghe An had a higher iron content than the rice in Thai Binh and Hanoi. This is attributed to the increased milling of rice in Thai Binh and Hanoi. Further study of different milling practices would be useful in determining whether large-scale changes in milling could effectively increase the iron available in the Vietnamese diet.

The higher iron value in unwashed rice suggests that further tests of iron content following several different washing patterns would be of interest. Unfortunately, it is unlikely that this would be of much practical use because cultural habits such as the washing of rice are deeply ingrained and unlikely to be changed without extensive advertising and education.

Conclusion
There is a higher vitamin C content in white water spinach than in red water spinach. Also, there is a higher iron content in hand-milled rice than in machine-milled rice, and in unwashed or minimally washed rice than in washed rice.

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