

Original Article

Iron and vitamin C content of commonly consumed foods in Vietnam

Bui Minh Duc,¹ Debbie Humphries,² Le Thi Bach Mai,¹ Ha Anh Dao,¹ Trinh Minh Co,¹ Huynh Hong Nga,¹ Phan Thi Kim¹

¹National Institute of Nutrition, 48 Tang Bat Ho Street, Hanoi, Vietnam

²Division of Nutritional Sciences, Savage Hall, Cornell University, Ithaca, New York 14853, USA

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.

Introduction

This research was conducted as part of a larger research project which looked at the causes of anaemia in women aged 15–49 years and children aged from 6 months to 5 years in Vietnam. The two study sites were in Nghe An province in northern-central Vietnam and Thai Binh province in the Red River Delta.

As part of the larger study, 528 women between the ages of 15 and 49 years and 331 children between the ages of 6 months and 5 years were questioned about their dietary intake on the previous day. Of the 528 women, 427 (81%) had eaten water spinach on the previous day. Of the 331 children, 99 (30%) had eaten water spinach on the previous day. This made water spinach the second most commonly eaten food, after white rice. For this reason, white rice and water spinach were selected for chemical analysis in order to determine whether there were variations in the iron and vitamin C content of these primary food sources between Nghe An province and Thai Binh province. It was thought that this might explain some of the variation in haemoglobin levels between the two locations.

Water spinach belongs to the family Convolvulaceae. Sweet potato is another common member of this family. Water spinach is eaten frequently throughout South-East Asia, Hong Kong, Taiwan and southern China.¹ There are two types of water spinach grown in Vietnam: red and white. Water spinach is a short-day plant (i.e. with a short harvest cycle), planted by seed or stem cuttings in the lowlands, and harvested for up to 9 months of the year.¹ The young tops or plants (stem and leaves) of water spinach are boiled or fried in oil and eaten in various dishes such as salad or soups, or they are pickled. In Vietnam, water spinach represents an inexpensive source of many valuable nutrients.

Materials and methods

Sample collection

Samples of raw rice, cooked rice and water spinach (*Ipomoea aquatica* Forsskal) were taken from households in each of three communes. Each sample was approximately 1 kg in weight. Two of the communes were adjacent communes in Nghe An province, Thanh Chuong district. The third commune was in Thai Binh province, Thai Thuy district. In each commune the samples were collected on a Saturday, and then refrigerated and returned to Hanoi on a Sunday (i.e. the following day). Analysis was conducted in Hanoi on the next day, Monday, at the laboratories of the National Institute of Nutrition. Comparison samples were purchased at markets in Hanoi.

Iron content analysis

Samples of approximately 10 g were accurately weighed and dried at 100°C. Dried samples were ashed at 550°C until completely white. Ashes were mixed with 10 mL of 32% HCl, and then boiled until dry. Following this, 5 mL of 20% HCl were added and residues were dissolved and filtered through non-ash filter paper, with multiple washings using hot distilled water. Distilled water was added to the filtered solution to make up 100 mL.

The sample was mixed with 10% HCl and 50% NH₄SCN (Association of Official Analytical Chemists, Arlington, VA, USA; 14 ed. 1984, 2126–2130, 7.096). Absorption was then measured at 480 nm on a Varian 634 spectrophotometer (Techtron Pty Ltd, Australia). Results were then compared

Correspondence address: Bui Minh Duc, National Institute of Nutrition, 48 Tang Bat Ho Street, Hanoi, Vietnam.
Tel: 844 971 7090; Fax: 844 971 7885.
Email: nin@netnam.org.vn

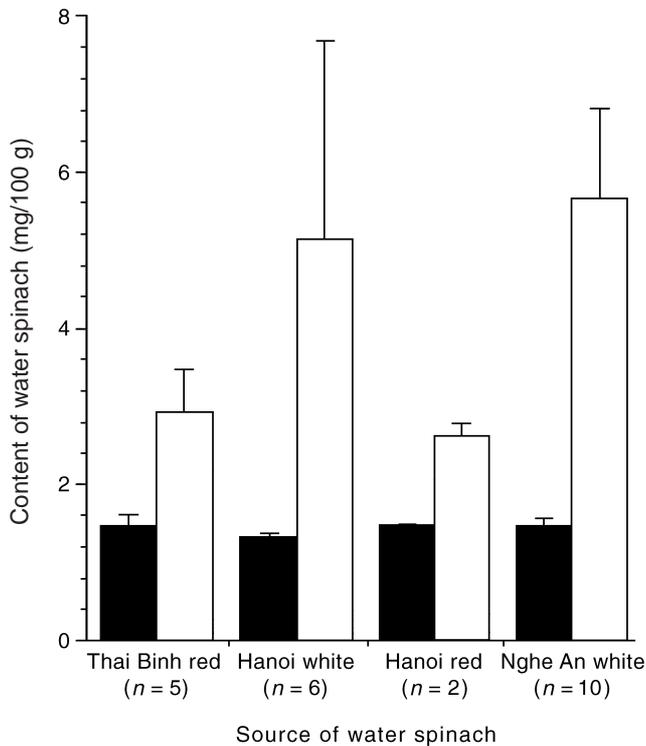


Figure 1. Vitamin C and iron content of water spinach. (■) iron; (□) vitamin C.

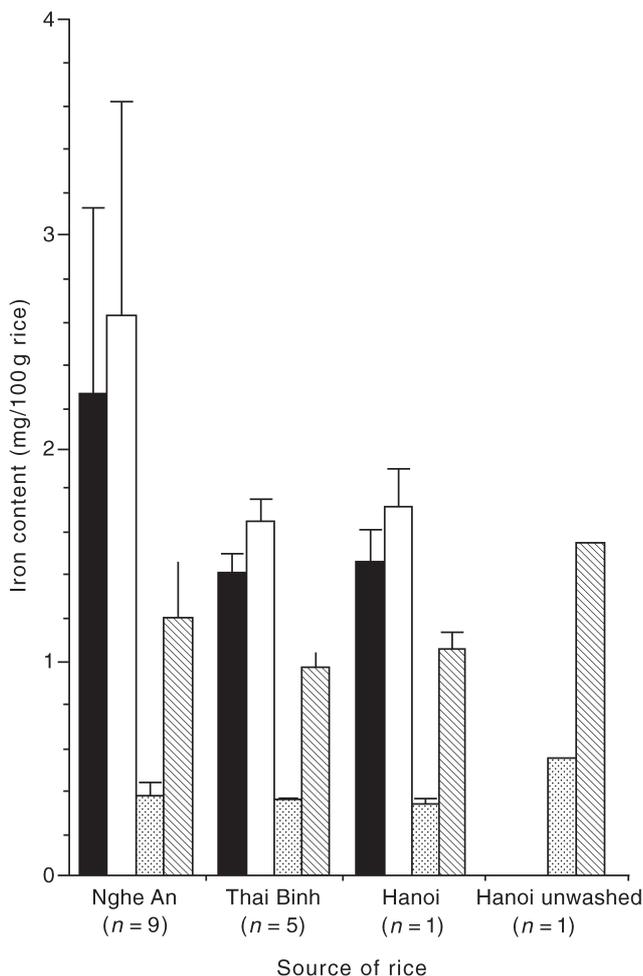


Figure 2. Iron content of cooked and uncooked rice. (■) raw; (□) raw, dry weight; (▨) cooked; (▩) cooked, dry weight.

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.

Acknowledgements. We wish to express our deepest thanks to Prof. Tu Giay, and Prof. Ha Huy Khoi, Director NIN, for their critical reading and helpful advice in the study and preparation of this report. The authors are grateful to the Director, Department of Nutritional Sciences, Cornell University, New York, and OSPAM Hanoi, for providing facilities and finance for this work.

References

1. PROSEA-8. Plant Resources of South East Asia 8, Vegetables. Bogor, Indonesia. The Netherlands: Wapeningen Agricultural University, 1994; 181–184.
2. Ballot D *et al.* Factors influencing the absorption of iron from soy bean protein products. *Br J Nutr* 1987; 57: 345–353.