IRON CONTENT OF TWENTY-FIVE INDIGENOUS GREEN LEAFY VEGETABLES

BY

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CONTENTS

ABSTRACT

Twenty-five indigenous green leafy vegetables in Ghana were analyzed for their iron composition. Varietal differences of iron content were observed for the green leafy vegetables with a least iron content of 11.2 ± 0.05 mg/100g (dw) for variety TA/97/160-C4 to the highest value of 43.4 ± 0.01 mg/100g (dw) for SO/2002/002-D3. Results obtained fell in the range of published values for good iron levels in green leafy vegetables.

1.0 INTRODUCTION

Vegetables are an important component of a healthy diet. They are either eaten fresh or prepared in a variety of ways. The nutritional significance of green vegetables in the human diet has to do primarily with their contribution to the daily intake of minerals and vitamins. Although they do not contain large amounts of some of these nutrients, they are usually rich in iron and provitamin A, and often in the B complex vitamins (Meyer, 1960).

Native plants are often utilized, mostly in the form of tender shoots and leaves for soups and stews. As a rich source of iron, green leafy vegetables could help alleviate the pernicious effect of iron deficiency, which still remains a common nutritional disorder and hence a major public health threat.

Iron deficiency is estimated to affect 2 billion people (about one-third of the world population) of whom 1.2 billion suffer from iron deficiency anemia (SCN News, 2002). Though iron deficiency can be caused by parasitic infections; particularly hookworm and malaria, insufficient intake of iron rich foods is attributed to be the major cause of this nutritional disorder (Gillespie, 1998).

Ghana abounds with a lot of vegetables. This study, therefore, seeks to demonstrate the iron potential inherent in these indigenous green leafy vegetables and hence expand and also diversify the sources of dietary iron. This store of knowledge will help people make nutritionally informed choices in their intake of vegetables to meet their iron requirements.

The specific objective of this study is to determine the iron content of twenty-five indigenous vegetables from the experimental lines of the Genetic Resources Center, Bonsu, Eastern Region.

2.0 LITERATURE REVIEW

2.1 Nutritional significance of vegetables

The classes of food called vegetables according to Latham (1997) and Meyer (1960) include leaves (e.g. amaranth and cabbage), roots (e.g. carrot and turnips), vegetable fruits (e.g. tomatoes and eggplant) flowers, buds and stems (broccoli, cauliflower, artichoke, celery and asparagus). Vegetables vary greatly in colour, texture and their complex aromas, resulting in increased palatability and other beneficial quality attributes of diets.

Many green leafy vegetables are grown in West Africa and these varieties are found in any big market in the Sub region. Such vegetables, according to Sai (1976) have little calorie value: low fat and carbohydrate content. The limited protein they contain is, however, very useful for supplementing the protein lacking in the staple.

Green leafy vegetables supply many nutritive requirements and are normally rich in carotene – often called provitamin A because this substance can be turned into vitamin A in the human body (Sai, 1976). They are also essential for their vitamin C content and contain significant amounts calcium, iron, thiamin, riboflavin and nicotinic acid (Vierra, 1996; Sai, 1976). They usually have a moisture content ranging from 70 – 98% (Meyer, 1960) and a large proportion of their content consist of indigestible residue which serve as a source of dietary fibre (Latham, 1997).

On a worldwide basis and especially in the developing world, vegetables make up a considerable part of the diet. Nearly all types of vegetables are eaten soon after they are harvested, unlike nuts, cereals and tubers; they are rarely stored for long periods. (Vierra, 1996; Fellows, 1997 and Latham, 1997). This is due to their high moisture content and low acid levels which render them highly perishable.

The dark green vegetables are more valuable in these tropical diets because they contain far more carotene and vitamin C, as well as more calcium and iron than the pale green leaves and other vegetables (Borget *et al.*, 1966 and Latham, 1997). Thus amaranth is much more superior to cabbage or lettuce in terms of nutritive value (Sai, 1976; Rozychi *et al.*, 1997). Barimas *et al.* (1998) determined the mineral composition of six non-conventional leafy vegetables largely consumed by the rural populace of Nigeria. Their findings indicated that mineral contents appeared to be dependent on the type of vegetable and *Amaranthus spinosus* and *Adonsonia digitata* leaves had the highest levels of iron (38.4 mg/100g and 30.6 mg/100g dw, respectively). In Cote d'Ivoire, Herzog *et al.* (1993) also determined the overall composition – vitamin, carotene and mineral – composition of the leaves of four wild plants that are used as vegetables in the traditional cuisine of the country. The leaves – *Ceiba pentandra, Grewia carpinofolia, Hibiscus congestiflorus* and *Triplochiton scleroxylon* – were found to be very good sources of iron and calcium with values falling within the range of data published for domesticated leafy vegetables. Similarly, Nordeide *et al.* (1996) studied four green leaves (*Adansonia digitata, Amaranthus viridis, Tamarindus indica* and *Allium cepa*) in Koutiala, an agricultural district in Mali. They found these green leafy vegetables to be rich in iron and calcium and concluded that they were valuable nutrient contributors in the diet; in both rural and urban areas, but most importantly in the rural areas.

2.2 Iron from Plant Source

There are two types of iron in food namely haem and non-haem iron. Haem iron (Fe^{2+}) is obtained from animal source whereas non-haem iron is predominantly from plant sources. Sixty percent of iron from animal source is also non-haem iron and it is usually present as inorganic ferric (Fe^{3+}) complex salts (FAO, 1997; Williams, 1995). Iron in the ferric state is poorly absorbed because it is tightly bound in its food sources by certain anti nutritional factors Such as oxalic and phytic acids which occur naturally in a large number of plant species. When present in the human diet, they may combine with essential minerals such as iron and calcium to form insoluble salts known as oxalates and phytates and hinder the bioavailability of these minerals.

In his study on the antinutritional factors in sweet potato greens, Almazan (1995) determined the oxalic, phytic and tannic acids and trypsin and chymotrypsin content of three varieties of sweet potatoes. He observed varietal differences in oxalic, phytic and tannic acid concentrations and noted that conventional and microwave blanching in boiling water decreased their concentration in these vegetables. Trypsin and chymotrypsin inhibitors were not even detected in the fresh leaves. Wallace *et al.* (1998) also found oxalate, phytate, tannins, alkaloids and saponins in four non-conventional leafy vegetables. Iron is, however, more readily absorbed in the reduced (ferrous) state. Thus the presence in the diet of factors that enhance reduction or prevent oxidation – such as vitamin C and antioxidants – will favour the absorption of iron.

3.0 MATERIALS AND METHODS

3.1 MATERIALS

Grounded and dried samples of the following vegetables were obtained from the Plant Genetic Resources Centre, Bonsu, Eastern Region: *Cruntus, Talinum, Celosia, Marcrocarpon, C. olitorius*, OOA/96/163-A2, BTB/196/188-B2, BLM/2000/010-C2, AG/2000/020-D2, AG/2000/014-E2, AG/2000/041-A3, AG/2000/061-B3, FR/2002/004-C3, SO/2002/002-D3, AB/2002/005-E3, BTB/96/131-A4, FR/2002/002-B4, TA/97/160-C4, FR/2000/009-D4, BD/96/077-E4, FR/2002/008, AG/2000/021, AG/2000/027, 6A/96/061 and IF/2000/031.

3.2 METHODS

3.2.1 Ashing:

Samples were first ashed using the AOAC 1990 (15^{th} Edition) method. About 1 to 2 grams of samples were ashed in a Carbolite furnace (Carbolite Banfohd, Sheffeld, England). The ash solution was prepared by adding 10 ml of (1 + 1) Hydrochloric acid to the ash in the crucibles and heating for 10 minutes.

3.2.2 Iron Determination:

Two milliliters aliquot of the ash solution was pipetted into a 50 ml volumetric flask. 0.3 g of crystalline ascorbic acid was added. The solution was then left to stand for ten minutes to allow complete reduction of iron to the ferrous state. Ten milliliters of ammonium acetate was added to the solution followed by 2 ml of 2, 2-dipyridyl solution and the flask was placed in the dark for 60 minutes to ensure full colour development. The solution was then made up to the mark of 50 ml with distilled water and absorbance read at 470 nm with the Perkin Elmer 295E spectrophotometer (Perkin Elmer Co. Britain).

A standard curve (absorbance (nm) against concentration µg/ml) was prepared using 0.5, 1.0, 2.0, 3.0, 5.0 and 10.0 ml of standard iron solution (10 micrograms in 1 ml) diluted in 100 ml volumetric flasks respectively. The iron contents of the vegetables were calculated as follows:

$$\text{Iron (mg/100g)} = \frac{250 \times C.R.}{Wt \times Vol}$$

Where C.R. = concentration of 2 ml aliquot from standard curve reading

Wt = weight of sample ashed

Vol = volume of aliquot taken.

4.0 RESULTS AND DISCUSSION

Table 1: Iron levels in 25 indigenous vegetables (mean ± SD)

SAMPLE NAME	Iron (mg/100g)	SAMPLE NAME	Iron (mg/100g
C. OLITORIUS	18.6±0.03	SO/2002/002-D3	43.4±0.01
CRUNTUS	24.8±0.02	AB/2002/005-E3	18.7±0.06
TALINUM	36.6±0.88	BTB/96/131-A4	31.0±0.03
CELOSIA	37.4±0.04	FR/2002/002	18.7±0.02
MARCROCARPON	24.9±0.02	TA/97/160-C4	11.2±0.05
OO/96/163-A2	24.9±0.01	FR/2000/009-D4	23.6±0.23
BTB/196/188-B2	31.0±0.01	BD/96/077-E4	12.4±0.02
BLM/2000/010-C2	18.6±0.04	FR/2002/008	24.9±0.02
AG/2000/020-D2	18.7±0.02	AG/2000/021	30.9±0.33
AG/2000/014-E2	31.0±0.01	AG/2000/027	21.2±0.02
AG/2000/041-A3	24.9±0.07	6A/96/061	25.2±0.27
AG/2000/016	24.9±0.01	IF/2000/031	25.0±0.02
FR/2002/002	18.6±0.03		

The iron levels (dry weight basis) in the twenty-five indigenous vegetables are presented in table 1. The values obtained ranged from 11.2±0.05mg/100g to 43.4±0.01mg/100g. The results fall within published values for good source of iron (Barimas *et al.,* 1998). The differences observed in the iron content of the vegetables can be attributed to the differences in variety, soil conditions and maturity at harvest.

In a similar study Khader and Rama (1998) determined the mineral contents of some leafy vegetables in India at three different stages of maturity. Apart from the varietal differences, they also found out that as the plants matured from 15 days to 30 days, iron and manganese contents increased whereas zinc and copper contents decreased.

Although the results obtained shows these indigenous vegetables are good sources of iron, their importance as valuable contributors to good iron nutritional status will depend largely on the serving portions eaten and the bioavailability of iron from them. The anti nutritional factors – oxalic and phytic acids – present in plants interfere with the absorption of iron from plant sources. However, including a good source of vitamin C in the diet enhances absorption and eating a generous serving portion will boost the chances of meeting the Recommended Daily Allowance of 10 mg/100g for children and men; and 15 mg/100g for women (Williams, 1994).

5.0 CONCLUSION

The twenty five indigenous vegetables studied were good sources of iron. The differences observed in the iron content makes it imperative that these vegetables are carefully selected to maximize the intake of this micronutrient. It is recommended that future studies on these leafy vegetables should include antinutritional factors and the bioavailability of iron from these vegetables.

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