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The Effect of Boiling on the Nutrients and Anti-Nutrients in Two non Conventional Vegetables

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Abstract: The effect of boiling on the nutrient and anti-nutrient composition of two vegetables *Solanum nigrum* and *Solanecio biafrae* was investigated. The vegetables were boiled and the boiled and raw samples were analysed for proximate composition and some anti nutritional compounds. The protein, ash, fat and fibre in *Solanum nigrum was* found to be 4.63, 2.99, 0.96 and 1.13%, respectively while *Solanecio biafrae* were 4.03, 2.86, 0.92 and 1.05% for protein crude ash, fat and fibre, respectively. All the nutrient contents were reduced after boiling with a percentage of between 28 and 9.78% with the exception of ash where the percentage loss was 59.79 and 58.52% in *Solanecio biafrae and Solanum nigrum*, respectively. All the antinutritional compounds investigated were found in the vegetable. The Phytate, tannin, nitrate and oxalate in *Solanum nigrum* was 1.65, 0.83, 0.36 and 0.50%, respectively and 1.88, 0.92, 0.33 and 0.46% was recorded for *Solanecio biafrae* for phytate, tannin, nitrate and oxalate, respectively. These antinutritional compounds were reduced after boiling by between 39.7% in Tannin and 20% in Oxalate. These vegetables were not rich in nutrients like some other conventional vegetables; they were also low in antinutritional content. Most of the nutrients are stable after processing except the minerals as indicated by the ash result, yet the antinutrient were easily destroyed by boiling.

Key words: Nutrients, anti-nutrients, boiling, 'worowo', 'odu'

INTRODUCTION

Vegetables are edible parts of the plants, which are usually cooked and salted before consumption with other foods. From the food science perspective it may include the following; Leaves, stems, roots, flowers, seeds, fruits, bulbs, tubers and fungi. There are thousands of plants that are used as vegetables; these plants belong to different botanical classes. They may be cultivated or wild, may be trees, herbs, shrubs, climbers, or erect plants that cut across the plant kingdom, certain fruits such as tomatoes, egg plant and beans are used as vegetables. In the group of vegetable crops, leafy vegetables are among the most important sources of mineral compounds. The high biological value of leafy vegetables depends on the pronounced content of the minerals compound especially, calcium, magnesium, phosphorus and iron (Jaworska and Kmiecik, 1999). In general these crops also contain significant amounts of beta-carotene, folic acid and dietary fibre. Of this group of vegetables, leafy vegetable are seasonal crops with a limited value for processing (Takebe *et al*., 1995).

The protein in leaves is low but what is present is of the high grade. The quantity of vitamin E in leafy vegetables increases with their greenness (Kochhar, 1981). Antinutritional factors have been reported in vegetables (Besche *et al*., 1998, Jaworska and Kmiecik, 1999). Nitrate, phytate, tannin and oxalate are considered as undesirable compound as well as anti-nutritional in vegetables (Besche *et al*., 1998).

Fresh succulent leaves of *Solanecio biafrae* also known as "Worowo" in Western Nigeria is a popular leafy vegetable in Sierra Leone, Ghana, Benin, Nigeria, Cameroon and Gabon. They are usually cooked with pepper, tomato and onions. In such dishes there is no need for meat or fish because of the excellent properties of the vegetable, reflected in the Yoruba proverb 'vegetable soup prepared with 'worowo' does not need meat'. However, fish or meat may be added to the soup. In Sierra Leone, where it is called 'bologi', the leaves are eaten as a steamed vegetable in combination with okra and fish (Adebooye, 2004).

Night shade also known as "Odu" (*Solanum nigrum*) is an annual plant; it is commonly consumed as cooked complement to the major staples food like cassava, yam etc.

The aim of this present research was to evaluate the nutritional and selected antinutritional content in these two wild vegetables and determine the extent of the effect of boiling on the quality of these vegetable.

MATERIALS AND METHODS

Source of raw material: The materials investigated were the leaves of *Solanum nigrum* (Night shade "Odu") and *Solanecio biafrae* ('Rorowo') freshly collected from Ita-Ore, Ekiti State, Nigeria.

Chemical analysis were carried out at I.A.R. and T. All chemicals used were of analytical grade and the experiments were carried out in Triplicate.

Sample preparation: The vegetable samples was trimmed and washed with clean water. The cleaned vegetable was cut as needed. Four litres of clean water was put inside pot and boiled at the temperature of 100°C and 500 g of the cut vegetable was placed inside the boiling water and was allowed to boil for 15 min.

Method: Samples were analyzed chemically for moisture, protein, fat, crude fibre and ash content according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C, 1994). All analyses were carried out in triplicate. Carbohydrate was calculated by difference.

Tannin, oxalate, phytate and nitrate content were determined according to the official methods of analysis described by the Association of official Analytical chemist (A.O.A.C, 1994). All analyses were carried out in triplicate.

RESULTS AND DISCUSSION

The results of the analysis presented in Table 1 shows that the percentage moisture content of raw "worowo" *Solanecio biafrae* and "odu" *Solanum nigrum was* 89.68 and 89.49%, respectively this value increased after boiling by 5.85% in *S. biafrae* and 6.51% in *S. nigrum*. These values are comparable to the moisture content reported for *Amaranthus*, (85%) *Telliferia* (86.1%) and *Veronia amygdalina* (83.8%) (Kochhar, 1981; Ball, 1989). The increase in moisture content could be as a result of water absorption by the fibres and other natural chemical component of the vegetables.

The fat content of raw *Solanecio biafrae* and *Solanum nigrum* was 0.92 and 0.96%, respectively. These values were significantly lower than that of *Telfairia Occidentalis* (11.6%) and *Amaranthus cruentus* (5.3%) (Kochhar, 1981), but higher than the value reported for *Laurea tetraxidicollie* (0.20%) and *Basella rubra* (0.30%), respectively (Isa *et al*., 2006). With boiling the fat must have melted into the boiling water thus causing a reduction in the fat content. However *Solanecio biafrae* was able to retain more of the fats and lost about 9.7% while *Solanium nigrum* recorded about 16% loss. The same trend was reported by Kochhar (1981) for *Amaranthus cruentus* and *Telfairia Occidentalis*.

The protein content of raw *Solanum nigrum* and *Solanecio biafrae* was 4.63 and 4.3%, respectively these value is within the range of the protein content in green leafy vegetables (Ball, 1989) but it is higher than the value 1.20 and 1.93% reported for *Laurea tetraxidicolie* and *Basella rubra*, respectively (Isa *et al*., 2006). The protein content of the sample reduces after boiling to 3.68 and 2.98% in *Solanum nigrum* and *Solanecio biafrae*, respectively. During boiling cellular protein are denatured and the chlorophyll which are bound to protein may be released such free chlorophyll are highly unstable and are readily converted to pheophytin which is olive green to brown in colour (Komolafe and Obayanju, 2003).

Table 1: The result of nutritive composition of boiled and raw *Solanecio biafrae* (Rorowo) and *Solanum nigrum* 'Odu'

Parameter	*Solanecio biafrae* (%)	*Solanium nigrum* (%)
Raw		
Crude protein	4.03±0.00	4.63±0.00
Crude fat	0.92±0.00	0.96±0.00
Crude fibre	1.05±0.00	1.13±0.00
Ash	2.86±0.00	2.99±0.00
Moisture	89.68±0.00	89.49±0.00
Boiled		
Crude protein	2.98±0.00	3.68±0.00
Crude fat	0.83±0.00	0.80±0.00
Crude fibre	0.86±0.00	0.93±0.00
Ash	1.15±0.00	1.24±0.00
Moisture	95.25±0.00	95.72±0.00

Table 2: The result of anti-nutritional composition of boiled and Raw *Solanecio biafrae* (Rorowo) and *Solanum nigrum*

Parameter	*Solanecio biafrae* (%)	*Solanium nigrum* (%)
Boiled		
Phytate	1.42±0.00	1.26±0.00
Oxalate	0.36±0.00	0.40±0.00
Nitrate	0.20±0.00	0.28±0.00
Tannin	0.65±0.00	0.50±0.00
Raw		
Phytate	1.88±0.00	1.65±0.03
Oxalate	0.46±0.00	0.50±0.00
Nitrate	0.33±0.00	0.36±0.00
Tannin	0.92±0.00	0.83±0.00

The ash content of raw *Solanum nigrum* and *Solanecio biafrae* was 2.99 and 1.05%, respectively this is significantly lower than that of *Cnidosculus aconitifolius*, *Telfairia occidentalis and Amaranthus cruentus* which are 11.. 30, 13.25 and 8.80%, respectively (Kochhar, 1981). Ash content is an indication of the mineral content, these low values shows that the vegetables are low in mineral content. After boiling there was reduction in the ash content up to 59.79% in *Solanecio biafrae* and 58.52% in *Solanum nigrum*. This reduction in ash content may be due to leaching of the mineral compound into the boiling water.

The fibre content of *Solanum nigrum* and *Solanecio biafrae* was 1.13 and 1.05%, respectively these values are comparable to 0.70 and 0.90% reported for *Laurea tetraxidicolie* and *Basella rubra*, respectively (Isa *et al*., 2006). The fibre content of the sample reduces after boiling to 0.93 and 0.86%, respectively; this result shows that boiling reduces the fibre content of *Solanum nigrum*

The result of analysis of antinutrients is presented on Table 2. The result shows that the total oxalate in raw *Solanum nigrum and Solanecio biafrae* was 0.50 and 0.46%, respectively the value is lower compare to the 0.97, 0.94, 8.86 and 2.81% reported for *Cnidosculus aconitifolious*, spinach, *Amaranthus cruentus* and

ipomea aquatica, respectively (Schmidt *et al*., 1971; Jaworska and Kmiecik 1999; Ajala and Oloye, 2005). Oxalate content reduces after boiling to 0.40 and 0.36%, respectively. Oxalates are regarded as undesirable constituent of the diet, reducing assimilation of calcium, favouring the formation of renal calculi (Faboya, 1990). Apart from genetic factors, the chemical composition of vegetables including the content of compound both beneficial and undesirable in the diet, it is significantly affected by agrotechnical measure, soil fertility as well as weather conditions (Takebe *et al*., 1995; Grevenson and Kaack, 1996; Schmidt, 1971).

The result of Nitrate content for *Solanium nigrum* and *Solanecio biafrae* was 0.36 and 0.33% this values are lower than 0.67 and 0.39% reported for Amaranthus cruentus and *ipomea aquatica*, respectively (Schmidt, 1971; Jaworska and Kmiecik, 1999). The low nitrate concentration in *Solanecio biafrae and solanium nigrum* may be attributed to their growth on uncultivated land, since nitrate in vegetable is due to nitrate fertilization used to push growth of the plant (Sarojini, 1998). The nitrate toxicity in the body result to methemoglobinemia which results in death (WHO, 1997). After boiling the reduction in nitrate was 39.39% in *Solanecio biafrae* and 22.2% in S*olanium nigrum*.

The phytate content of *Solanium nigrum* and *Solanecio biafrae* was 1.65 and 1.88% these values is significantly lower than what was reported for *Cnidosculus aconitifolius* where, 3.62% was reported Presence of phytic acid in food leads to inhibition of some minerals such as Calcium (Kochhar, 1981). Phytate can also affect digestibility by binding with substrates or proteolytic enzymes (Oguntona, 1998). In the boiled sample 1.26 and 1.42% phytate was recorded, respectively.

The tannin content in *Solanium nigrum* and *Solanecio biafrae* was 0.63 and 0.92%, respectively these value are lower to that of *Cnidosculus aconitifolius*, where the tannin content was recorded as 2.63% (Aletor and Adeogun 1995).

Tannin is known to be bitter and form high polyphenol complex with protein thereby making it unavailable in the diet Tannin may decrease protein quality by decreasing digestibility and palatability Tannin in fruits imports an astringent taste that affects palatability, reduce food intake and consequently body growth. Tannins are known to inhibit the activities of digestive enzymes and nutritional effects of tannin are mainly related to their interaction with protein. Tannin protein complexes are insoluble and the protein digestibility is decreased (Carnovale *et al*., 1991; Bello *et al*., 2008). Boiling reduces the tannin content to 0.50 and 0.65% in *Solanium nigrum* and *Solanecio biafrae*, respectively.

Conclusion: The nutrient contents of the leafy vegetables serve as supplements for food and also have the potential to improve the health status of its users as a result of the presence of various compounds vital for good health. *Solanium nigrum* and *Solanecio biafrae* are really not rich in the nutrient investigated compared to other common vegetables as discussed above, but their anti-nutrient content is appreciably low such that the little available nutrient can be adequately utilized in the body.

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