

CHAPTER 10

NUTRITIONAL VALUE OF THE TUBERS

10.1 Introduction

The tubers of *Plectranthus esculentus* can be eaten raw, baked, or cooked as a vegetable (Tindall, 1983; Tregold, 1986; Temple, Ojobe & Onobun, 1991). These organs are very rich in starch, and are used as a source of food. This plant used to be widely cultivated for the edible tubers in some areas of South Africa. Its use has declined with the years due to a variety of reasons, not least of which is a loss of planting material due to climatic changes (Beck, 1995 - personal communication¹), as well as the social stigma which is now attached to the use of “wild” plants.

Due to its wide adaptation, this root crop is being evaluated as a possible vegetable crop for use in areas of low agricultural potential, which are generally unsuitable for the production of exotic vegetable species. The nutritional value of most tuber crops has not received much attention and they are often only classified as being starchy foods, and the value of their vitamins, minerals and even proteins is often overlooked (Plucknett, 1983). Before any plant can be recommended as a foodstuff, it is important that the nutritional value is known. The objective of this study was to determine the nutritional value of the tubers of *Plectranthus esculentus* plants from South Africa.

10.2 Materials and Methods

Tubers from *Plectranthus esculentus* were selected from plants cultivated in the field genebank, as well as from research trials carried out at the ARC-Roodeplaat Vegetable and

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Ornamental Plant Institute during the 1995/96 season. The tubers were sliced, freeze dried in order to preserve the vitamins, and analysed by the ARC-Animal Nutrition and Animal Production Institute. Moisture content was determined in a vacuum oven. Crude protein ($N \times 6.25$), crude lipid and total ash were determined using standard methods (AOAC, 1975). Each analysis was replicated four times and the mean value reported. All analyses were carried out by means of chromatography, with the exception of the carbohydrate content, which was determined by the difference method (AOAC, 1975).

The material was analysed for Vitamins B₁, B₂, B₆ and A, using standard methods for preparation and analysis (AOAC, 1975). Vitamin A was determined in the form of β -carotene. This value was converted to retinol (vitamin A) equivalents. Values for the phosphorous (P), potassium (K), calcium (Ca), magnesium (Mg), zinc (Zn), copper (Cu), manganese (Mn), sodium (Na), and iron (Fe) were determined, and the amino acid composition of the protein was ascertained.

10.3 Results and Discussion

Although nine minerals were analysed in the course of this trial, only calcium and iron are crucial from a nutritional point of view, as deficiencies of either of these elements cause severe health problems. Calcium is required to build a strong bone structure, while iron forms an essential part of the red blood cells (West, 1987). Table 10.1 shows the amounts of these two minerals in tubers of a number of common root and tuber crops. From Table 1 it is can be seen that *Plectranthus*, whether from South Africa or Nigeria, provides more calcium and iron than either potato or sweet potato. It can also be seen that the variety from South Africa apparently contains approximately 15% more calcium, and much more iron than the Nigerian variety.

The proportion of the Recommended Daily Allowance (RDA) of Ca and Fe provided by 100g portions of these root and tuber crops can be seen in Figure 10.1. The RDA reflects the level of a nutrient required in the diet to decrease the risk of chronic diseases in most healthy individuals.

TABLE 10.1 Calcium and iron content of various tuber crops (mg.100g⁻¹)

Crop	Calcium	Iron
<i>Plectranthus esculentus</i> (South Africa)	90.00	50.39
<i>Plectranthus esculentus</i> (Nigeria) (Temple <i>et al.</i> , 1991)	78.16	2.56
Potato (Potato Board, 1980)	13.00	1.10
Sweet potato (Brondal) (ARC, 1979)	12.80	0.40
Sweet potato (Mafutha) (ARC, 1979)	21.10	2.61

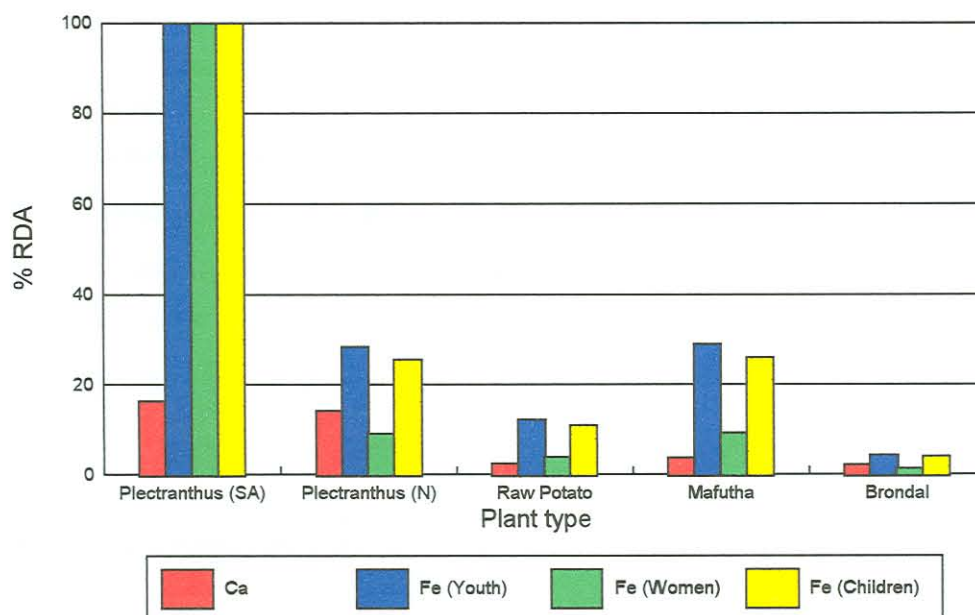


Figure 10.1 Percentage of the RDA of Ca and Fe provided by a 100g portion of various root and tuber crops

From Figure 10.1 it can be seen that a 100g portion of the South African *Plectranthus* can provide 16.4% of the RDA of calcium for a 14 to 18 year old male, females of the same age and children between one and five years old. The Nigerian variety provides 14.2% and the

two exotics contribute less than 4% of the RDA of this mineral. The provision of iron can also be seen in Figure 10.1, and it is apparent that the South African variety can supply more than 100% of the RDA for all groups, while the Nigerian variety as well as the sweet potato Mafutha provide 28%, 9% and 25% of the RDA for youths, young women and children respectively. The lowest contribution is made by the Irish potato and the white fleshed sweet potato (Brondal). However, it should be remembered that iron from an animal source is more easily absorbed than that from a plant source (West, 1987). This is probably due to the fact that much of the iron in plant foods is found in the form of poorly soluble iron phylate and iron phosphates (Potter, 1980).

The root and tuber crops are well known for the large contribution they make to the carbohydrate content of the diet. This is very important as it provides the energy source in the diet. From Table 10.2 it can be seen that the carbohydrate content of *Plectranthus esculentus* is higher than that found in either potatoes or sweet potatoes, with the South African variety having a value of approximately 3.5 times greater than that of potato and 2.5 times that of sweet potato. The Nigerian variety of *Plectranthus*, however, contains more than 30% extra carbohydrate than the South African variety. This difference may be ascribed to genetic differences between the two varieties, as well as climatic and edaphic factors, or differences in analytical procedures.

TABLE 10.2 Carbohydrate contents of various tuber crops (fresh plant material)

Crop	Carbohydrate (g.100g ⁻¹)
<i>P. esculentus</i> (South Africa)	52.0
<i>P. esculentus</i> (Nigeria) (Temple <i>et al.</i> , 1991)	57.4
Potato (Potato Board, 1980)	17.1
Sweet potato (Brondal) (ARC, 1979)	21.4
Sweet potato (Mafutha) (ARC, 1979)	25.3

Vitamin A is essential in the diet for the development of healthy eyes, as well as healing after an infection or injury, while the two B-group vitamins play a key role in many reactions that take place in the body, including those which make it possible to utilize the energy provided by the food which is taken in (West, 1987). A mild deficiency of vitamin A leads to night blindness, while a severe deficiency can lead to blindness (xerophthalmia) and even death in young children (Okigbo, 1990). Figure 10.2 shows that both potato and sweet potato provide more vitamin B₁ than *Plectranthus*, which in its turn provides more vitamin B₂ than the two exotics. The creamy-orange fleshed sweet potato Mafutha has a much higher β -carotene content than *Plectranthus*, which in turn has a greater value than that of the white fleshed sweet potato Brondal. It was unfortunately not possible to make a comparison with the Nigerian variety of *Plectranthus* as no data were available on the vitamin content of these plants.

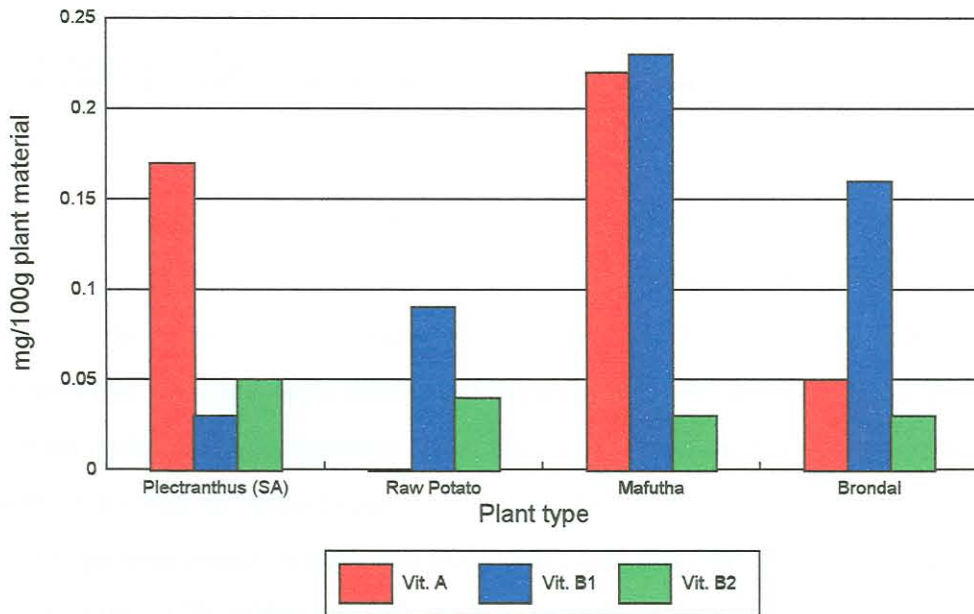


Figure 10.2 Amounts of three vitamins provided by a 100g portion of various root and tuber crops

Protein is necessary to build and maintain body tissue, and deficiencies cause severe malnutrition, particularly in infants and young children (West, 1987). Kwashiorkor is caused

by a protein deficiency, and this disease is prevalent in many of the arid and semi-arid areas of Africa. *Plectranthus esculentus* contains more than 7% crude protein on a dry matter basis, which is fairly high for a root or tuber crop. This value exceeds that obtained from both of the exotic species by several orders of magnitude (Table 10.3).

TABLE 10.3 Protein content of various tuber crops

Crop	Protein (g.100g ⁻¹)
<i>P. esculentus</i> (South Africa)	7.6
<i>P. esculentus</i> (Nigeria) (Temple <i>et al.</i> , 1991)	7.0
Potato (Potato Board, 1980)	2.1
Sweet potato (Brondal) (ARC, 1979)	1.0
Sweet potato (Mafutha) (ARC, 1979)	1.7

Figure 10.3 illustrates the contribution made by a 100g portion of *Plectranthus*, Irish potato and the two varieties of sweet potato to the daily protein requirement of 16 to 18 year old youths and young women, as well as children between 1 and 5 years old. From Figure 10.3 it can be seen that there are minor differences in protein content between the South African and Nigerian varieties of *Plectranthus*. It can also be seen that the tubers of the indigenous African plant provide far more protein to the diet than do either potato or sweet potato. With a 100g portion providing approximately 13% of the recommended daily allowance of protein for youths, 17% of that required by young women, and more than 40% of the daily protein requirement for children under the age of five.

It is not only the amount of protein that is important in the diet, but also the amino acid composition of the protein. There are eight amino acids which are particularly important from a dietary point of view, as the human body is unable to synthesize these compounds and they must be supplied in the diet. These are the so-called essential amino acids (Bell,

Davidson & Scarborough, 1965). Not only does *Plectranthus* contain a reasonable amount of protein, it also contains all eight essential amino acids. From Figure 10.4 it can be seen that the South African variety of *Plectranthus* contains a greater concentration of seven of the eight essential amino acids than the FAO reference protein (FAO, 1970), showing that the tubers of this plant provide a very well balanced protein. Isoleucine is the limiting amino acid in the South African *Plectranthus*, which has a greater concentration of all eight of the essential amino acids than the Nigerian variety, where methionine is the most limiting amino acid.

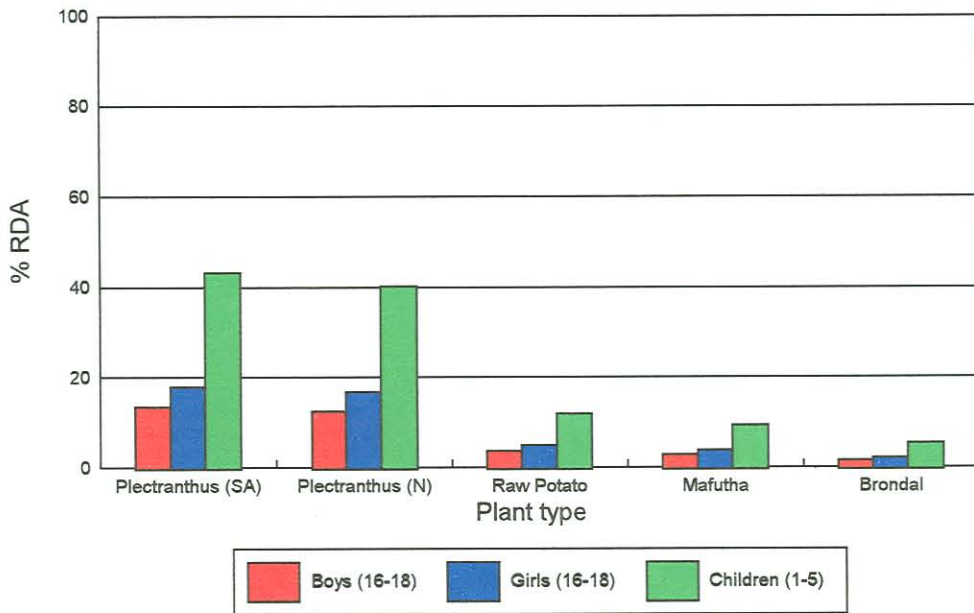


Figure 10.3 Percentage of the RDA of protein provided by a 100g portion of various root and tuber crops

Comparing these plants for the four crucial nutritional compounds, protein, vitamin A, calcium and iron (Figure 10.5), it can be seen that the South African variety of *Plectranthus esculentus* provides more of these nutrients than the Nigerian variety, as well as the potato and white-fleshed sweet potato. But it does not provide as much vitamin A as the creamy-orange fleshed sweet potato (Mafutha).

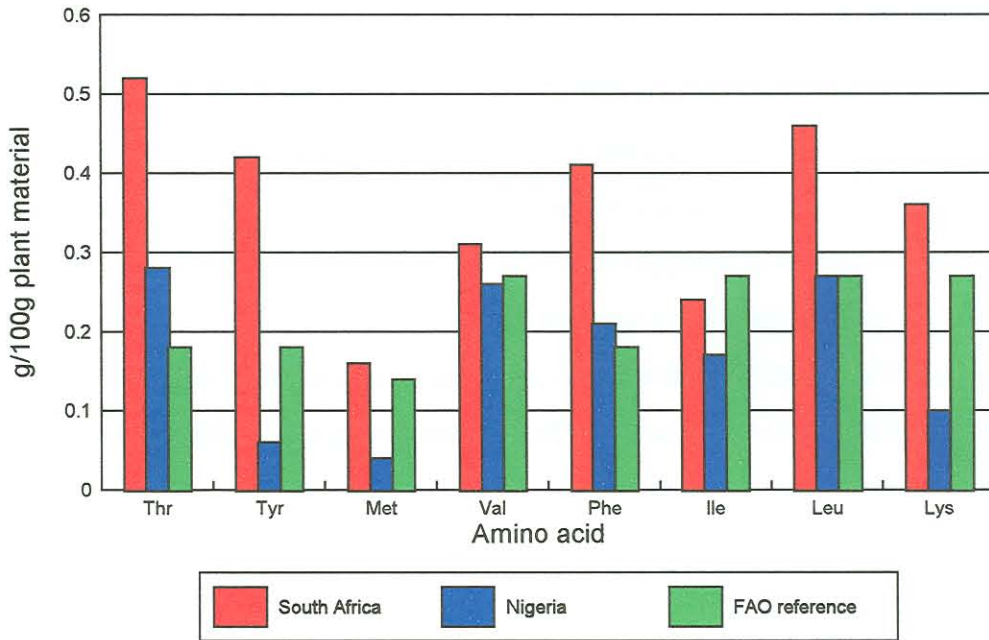


Figure 10.4 Amounts of essential amino acids provided by a 100g portion of South African and Nigerian *Plectranthus* varieties in comparison to the FAO reference protein

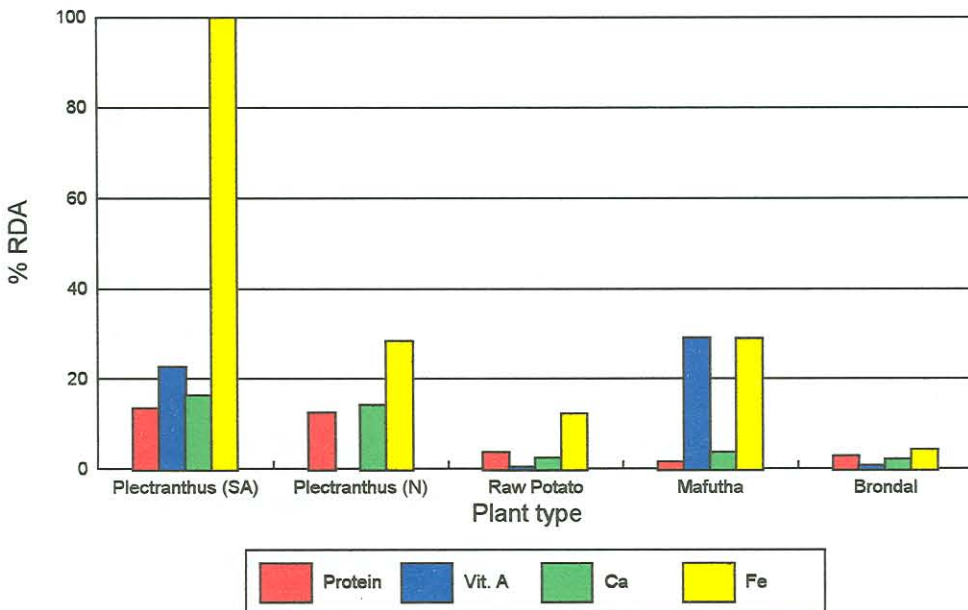


Figure 10.5 Percentage of the RDA for a 16 to 18 year old male of some crucial nutrients provided by a 100g portion of various root and tuber crops

10.4 Conclusions

From the results of this study it can be seen that *Plectranthus esculentus* can be a very valuable crop from a nutritional point of view, as it not only provides carbohydrate to the diet, but also appreciable amounts of protein. It is a very good source of vitamin A, Ca and Fe. The nutritional value of the South African variety appears to be similar to that of the Nigerian variety, but this cannot be confirmed without cultivating and analysing the two crops under identical conditions. It is, however, obvious that the tubers of this indigenous plant are more valuable from a nutritional point of view than those of similar exotics (potato and sweet potato). It therefore appears as though *Plectranthus esculentus* could make a contribution to food security in many areas of South Africa.

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