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Article *in* Journal of Food Agriculture and Environment · January 2006

4 authors, including:

Morufat Oloruntoyin Balogun
University of Ibadan

Olukayode Afolabi
Institute of Agricultural Research & Training

Kupolati Mojisola
University of Pretoria

WFL Publisher
Science and Technology
Journal of Food, Agriculture & Environment Vol.4 (1): 155-156. 2006
www.world-food.net

Sex differences in biochemical contents of *Telfairia occidentalis* Hook F.

S.R. Ajibade*, M.O. Balogun, O.O. Afolabi and M.D. Kupolati
Institute of Agricultural Research and Training, Obafemi Awolowo University, P.M.B. 5029, Ibadan, Nigeria.
**e-mail: saklaid@rediffmail.com, remiajibade2002@yahoo.com*

Received 8 August 2005, accepted 25 November 2005.

Abstract

In order to evolve ways of early sex identification in Telfairia, the biochemical contents of leaf, vine and root of male and female plants were determined in three genotypes. Female plants had significantly higher concentrations of protein and fat while the male plant was higher in fibre, ash and all the anti-nutrients. The concentration of trypsin inhibitor was most influential in distinguishing between the sexes especially for root and vines while the fibre content was most important for the leaf. Leaf fibre content is therefore recommended for sex identification since it can be easily determined at any stage of plant development without destroying the whole plant.

Key words: *Telfairia occidentalis*, sex, biochemical contents, fluted pumpkin.

Introduction

Fluted pumpkin *(Telfairia occidentalis)*, commonly known as ugu in Nigeria, is a nutritious leafy vegetable widely cultivated in the eastern part of the country [1]. Relative to most common vegetables, its protein content is high [10, 9]. The leaves and shoot are consumed as food [1]. The leaves are rich in iron and are used to cure aneamia. The oily seeds also have lactating properties and are widely consumed by the nursing mothers. The roots are known locally as potent human, fish and rodent poison [2]. The plants also contain considerable amount of anti-nutrients such as phytic acid, tannin and saponin [9], which could also have some health benefits [5].

Telfairia is, however, dioecious and the sex cannot be known until after flowering which takes about 4 months after planting. This is a major constraint to its production. The female leaves are preferred by the housewives and are therefore in higher demand. The female also produces seeds for future planting and this gives additional monetary returns to the farmers. It is therefore important to evolve ways of determining the sex of each plant at the early stage. This will enable farmers to adjust the sex ratio. Vegetative propagation of fluted pumpkin has been difficult and so efforts to use cuttings instead of seeds for planting has not been successful[1]. This paper describes differences in biochemical contents of the leaf, stem and root of male and female Telfairia for use in early sex identification.

Materials and Methods

In April 2004, seeds from three pumpkins of Telfairia, purchased from a local market in Ibadan, Nigeria, were planted on the field in rows at 1 m intra- and inter-row spacing. There were 6 stands per row, and the number of rows per pumpkin (genotype) depended on the number of seeds therein. The plants were staked individually and manual weeding was done as required. There was no fertilizer application.

At full maturity (8 months after planting) when the fruits were ripe, 3 male and 3 female plants were randomly sampled from each genotype by uprooting the whole plant. Each plant was separated into leaves, vines and root. For each plant part of each sex and genotype, quantitative analysis of the nutrients and antinutrients were done on fresh weight basis. Proximate analysis for crude fat, fibre and ash were carried out according to AOAC [3], while nitrogen content was determined by the micro-Kjeldahl method at a conversion factor of 6.25. The tannin, trypsin inhibitor, phytate, oxalate and saponin contents were determined [4, 6-8, 11]. There were 3 replicates, and two determinations per sample per replicate.

The experimental design was a 3 x 2 (genotype x sex respectively) factorial with sub-sampling [13]. The sub-samples were the component plant parts. Analysis of variance was performed on the data using SAS [12]. For the whole plant and for each plant part, data were also subjected to stepwise multiple regression [14], with sex as the dependent and the biochemical contents as the independent variables.

Results and Discussion

There were no significant differences among the three Telfairia genotypes for all the nutrient and anti-nutrient contents of the plants except for fibre (Table 1). Significant differences were, however, observed between the two sexes for all the biochemical contents except ash, carbohydrate and tannin contents of the plants (Table 1). These results indicate that these plant constituents could be used to differentiate between the two sexes.

Female plants had significantly higher concentrations of protein and fats, while the male plants had more fibre, ash and all the anti-nutrients (Table 2). In the market, vegetables from the male plants are discriminated against as housewives prefer to buy leaves of the female plants. The higher nutrient contents in females may be contributory to the high vigour associated with them. No significant genotype by sex interactions in the biochemical contents was observed, indicating that the differences in the plant constituents of the two sexes were the same across genotypes.

The biochemical contents differed significantly among the three

Table 1. Mean square values for the biochemical contents of *Telfairia* male and female plants.

Constituent	Source of variation			
	Genotype	Sex	Genotype x Sex	Plant part (within genotype x sex)
Protein	0.20	9.16^{x}	0.52	150.23^{xx}
Fat	0.18	1.12^{x}	0.54	43.28^{xx}
Fibre	0.11^{xx}	13.15^{xx}	0.001	93.67^{xx}
Ash	0.11	0.44	0.04	61.09^{xx}
Carbohydrate	0.58	0.04	0.44	345.32^{xx}
Tannin	0.003	0.02	0.003	0.04^{xx}
Phytate	0.002	0.11^{xx}	0.001	1.28^{xx}
Oxalate	0.001	0.09^{x}	0.002	0.99^{xx}
Saponin	0.001	0.06^{xx}	0.004	0.29^{xx}
Trypsin inhibitor	0.68	10.15^{xx}	0.18	485.97^{xx}

Significant at * 0.05 and ** 0.01%.

Table 2. Biochemical contents of the leaf, vine and root of Telfairia male and female plants.

Constituent	Female				Male			
	Leaf	Vine	Root	Mean	Leaf	Vine	Root	Mean
Protein (%)	20.77	11.15	7.28	13.07	20.27	10.12	6.34	12.24
Fat (%)	12.81	6.81	6.50	8.71	13.05	6.40	5.82	8.42
Fibre (%)	12.67	16.99	23.10	17.59	13.35	17.39	24.99	18.57
Ash (%)	14.02	7.26	6.31	9.19	14.89	7.05	6.18	9.37
Carbohydrate (%)	39.74	57.79	56.81	51.44	38.44	59.05	56.67	51.39
Tannin (g/100g)	0.34	0.17	0.18	0.23	0.40	0.26	0.16	0.27
Phytate (g/100g)	1.84	0.89	0.56	1.10	1.91	0.95	0.69	1.19
Oxalate (g/100g)	1.61	0.73	0.54	0.96	1.68	0.84	0.06	1.04
Saponin (g/100g)	0.84	0.40	0.28	0.51	0.93	0.51	0.30	0.58
Trypsin inhibitor (Tiu/mg)	35.94	18.42	11.83	22.06	37.40	18.89	12.50	22.93

plant parts (Table 1). In both sexes, the leaves had the highest concentrations of all the nutrients and anti-nutrients except for fibre and carbohydrate (Table 2). Despite these high anti-nutrients contents in leaves, there have not been reports of any harmful effects of its consumption. It will therefore be worthwhile to investigate whether the health benefits associated with leaf consumption is a function of the nutrients to anti-nutrients ratio or the actual quantity therein. Highest carbohydrate and fibre contents were recorded in the vines and root respectively. Although this study has shown that the roots had the lowest anti-nutrient contents, they are used locally as potent poison for rodents [2] and are not consumed by humans.

A regression of sex on the biochemical contents on whole plant basis revealed that none of the variables was significant in distinguishing the sexes. However, when regression was done based on each plant part, the results shown in Table 3 were obtained. The concentration of trypsin inhibitor is a strong factor in differentiating between the sexes in specific plant parts especially the roots and vines. For the leaf, which is the most important economic part of the plant [1], the fibre content is the most important factor as it explains about 94% of the differences between the leaves of the two sexes (Table 3). The significantly higher fibre content in the leaves of the male than the female plants can be used to distinguish between sexes as this can be easily determined at any stage of plant development without destroying the plant (Table 2). The use of this factor in sex identification should, however, be specific to genotype, since genotypes differed significantly with respect to the fibre content.

Table 3. Contributions of biochemical contents to sex differences in *Telfairia* based on stepwise regression.

Plant part	Constituent	$<R^2$	R^2
Leaf	Fibre	0.9424^{xx}	0.9424
	Trypsin inhibitor	0.0235^{xx}	0.9658
Vine	Trypsin inhibitor	0.9686^{xx}	0.9686
	Tannin	0.0162^{xx}	0.9848
	Carbohydrate	0.0045^{x}	0.9893
Root	Trypsin inhibitor	0.9741^{xx}	0.9741
	Fibre	0.0124^{x}	0.9865

Significant at * 0.05 and ** 0.01%. R^2 = coefficient of determination, $<R^2$ = partial R^2

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