

# MOISTURE CONTENT AND POLYPHENOL OXIDASE ACTIVITY OF GROWING *DIOSCOREA BULBBIFERA* AS INDICATORS OF TUBER MATURATION

A. E. ABARA, E. O. UDOSEN and O. U. EKA

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## ABSTRACT

The moisture content of  $61.93 \pm 0.25\%$  and polyphenol oxidase activity of  $40.50 \pm 0.68$  units per mg protein of the growing *Dioscorea bulbifera* (cultivar: round gunda) tuber measured using standard methods were found to be consistent with full maturation of the tuber. The significance of the established values rest on the assumption that they could be used to categorise the widely varied chemical data on tuber composition available in the literature into prematuration and postmaturation levels, a scheme which could be extended to other yam tubers if the values of these indicators at full maturation were similarly established. The proximate composition of *Dioscorea bulbifera* (cultivar: round gunda) consistent with the proposed indices of maturation of the tuber was also established.

**Key words:** *Dioscorea bulbifera*, moisture content, polyphenol oxidase.

## INTRODUCTION

*Dioscorea bulbifera* yam (aerial yam or air potato) together with other yams, cassava, cocoyam and potato belong to the group of crops termed roots and tubers, the main source of energy in the tropics. The importance of yams in the tropics and in the West African Sub-region had been discussed (Coursey, 1967; Onwueme, 1978). *Dioscorea bulbifera* is one of the yam species which is grown in the South East of Nigeria and is consumed mainly as boiled, fried or roasted yam along with meats, vegetables or with palm oil spiced with pepper.

The level of moisture in yams has been linked with the level of maturation of the tuber (Coursey and Walker, 1960) yet no attempt had been made to

use moisture content as an index of full maturation of yam tubers. The availability of such a criterion would have helped in streamlining the widely varying data on the chemical constituents of yams as encountered in the literature.

Browning of yam tubers has been of concern because of the aesthetic problems it creates besides lowering of the nutritional value of the affected food (Horigome and Kandatsu, 1968). Polyphenol oxidase has been reported to be the main enzyme responsible for the browning of many yam tubers and it has also been shown that this enzyme exhibits the highest activity in *Dioscorea bulbifera* amongst several yam species studied (Ikediobi and Obasuyi, 1982; Osagie and Okpoku, 1984). The intensity of browning in many

yam tubers depends upon the level of the enzymes and polyphenolic substrates in the tuber (Osagie and Okpoku, 1984; Ozo and Caygill, 1986), and so information on the activity of polyphenol oxidase during maturation of the tuber could be useful in predicting and relating browning intensity to the age of the tuber.

This study was aimed at using moisture content and polyphenol oxidase activity of the growing *Dioscorea bulbifera* tuber as indicators of maturation of the tubers. The values of these indicators could then be used to put in perspective the widely varied data so far available on the chemical composition and browning of the tuber.

## MATERIALS AND METHODS

The aerial yam, *Dioscorea bulbifera* (cultivar: round gunda) was planted in November during the early dry season in an experimental farm in Calabar in the rain forest belt of Nigeria on a typical loamy soil which was subjected to no further treatment.

### Sampling and Preparation of samples:

*Dioscorea bulbifera* yam tubers were harvested at two-weekly intervals from the farm upon the first appearance of the aerial tubers. Randomly selected tubers from the farm were harvested, peeled and sliced into pieces or crushed into pulp for use in analysis as needed.

### Crude enzyme preparation:

Polyphenol oxidase was extracted by the

method of Galeazzi et al (1981). 25g of the pulp were homogenised in a waring Blendor for 25 sec. with 50ml of a 0.2M sodium phosphate buffer pH 7.0 containing 1% insoluble polyvinylpyrrolidone to sequester interfering phenolic compounds. The homogenate was centrifuged at 4°C for 15 min and 12,000 x G. The active enzyme remained in the supernatant

#### Proximate Composition:

Moisture, ash, crude protein, crude fat and crude fibre were determined according to standard AOAC methods (1975). Carbohydrate was determined by difference. The energy value was calculated by multiplying the amount of protein (g) or carbohydrate (g) by a factor of 4 and the amount of fat (g) by a factor of 9 and added up together.

#### Polyphenol oxidase activity:

Polyphenol oxidase activity was determined by measuring spectrophotometrically at 420nm the rate of increase in absorbance at ambient temperature of a reaction mixture containing 2ml of 0.1M catechol solution, 1ml of distilled water and 2 $\mu$ l of the enzyme solution. The substrate solution mixed with distilled water was used as blank (Galeazzi et al, 1981). The straight line part of the activity curve obtained was used to express the enzyme activity in units per mg protein after the protein content of the enzyme solution had been determined.

#### Determination of protein in crude enzyme extract:

Protein in the crude enzyme solution was assayed by Biuret method. Using bovine serum albumin as standard protein, absorbances were measured at 550nm with WPA S305 Spectrophotometer. A calibration curve was prepared from which the protein concentration of the crude enzyme extract was read after treatment with biuret reagent and the absorbance

measured at 550nm. All determinations were carried out in triplicate.

## RESULTS AND DISCUSSION

The changes in the moisture content and polyphenol oxidase activity of the growing *Dioscorea bulbifera* tuber measured paripassu during a two-weekly interval is as shown in Table 1. The data showed that the moisture content of the maturing *Dioscorea bulbifera* tubers decreased continuously until a value of 61.93  $\pm$  0.25% was reached at full maturation which required fourteen weeks and at which point the aerial tubers fell on mere shaking of the plant. The data also showed that as the tuber of *Dioscorea bulbifera* matured, the activity of the enzyme polyphenol oxidase increased and attained a value of 40.50  $\pm$  0.68 units at full maturation of the tuber.

The moisture content of yam tubers has been reported to be related to the level of maturity of the tubers ( Coursey and Walker, 1960) and the data obtained in this study were in agreement with the report. Other factors besides the level of maturity of the tubers which may affect the moisture content of yams include cultivar, nature of soil, season of the year and method employed in the analysis.

The moisture content on wet weight basis of *Dioscorea bulbifera* tuber has been reported (FAO, 1968; Coursey, 1983; Egbe et al, 1984) to be 79.4%, 63.67% and 71.2% respectively. The moisture content of 61.93%  $\pm$  0.25% obtained for *Dioscorea bulbifera* in this study at full maturation was close to the value of 63.67% reported by Coursey (1983) while values reported by FAO (1968) and Egbe et al (1984) were higher and might reflect various stages of prematuration of the tuber. Similarly, moisture content values lower than 61.93  $\pm$  0.25% might be indicative of the length of post harvest storage period of the fully matured *Dioscorea bulbifera* tubers.

TABLE 1. CHANGES IN MOISTURE CONTENT AND POLYPHENOL OXIDASE ACTIVITY OF GROWING *Dioscorea bulbifera* TUBER

TIME (WEEKS)	MOISTURE (% WM)	POLYPHENOL OXIDASE ACTIVITY (Units/mg protein)
2	89.41 $\pm$ 0.97	15.39 $\pm$ 0.11
4	82.57 $\pm$ 0.45	19.71 $\pm$ 0.05
6	79.34 $\pm$ 0.30	25.99 $\pm$ 0.04
8	75.00 $\pm$ 0.64	32.63 $\pm$ 0.03
10	71.53 $\pm$ 0.50	38.48 $\pm$ 0.03
12	67.10 $\pm$ 0.10	39.49 $\pm$ 0.03
14	61.93 $\pm$ 0.25	40.50 $\pm$ 0.68

(MEAN OF THREE REPLICATES  $\pm$  SD)

WM = WET MATTER

MOISTURE CONTENT AND POLYPHENOL OXIDASE ACTIVITY OF GROWING *Dioscorea bulbifera* AS INDICATORS OF TUBER MATURATIONTable 2: PROXIMATE COMPOSITION OF MATURED *Dioscorea bulbifera* TUBERS (g/100g).

SAMPLE	MOISTURE	ASH	CRUDE PROTEIN	CRUDE FAT	CRUDE FIBRE	CARBOHYDRATE	ENERGY VALUE (kcal/100g)
WET MATTER	61.93±0.25	1.21±0.01	2.31±0.138	0.15±0.01	1.39±0.19	33.11±1.07	134.75±3.38
DRY MATTER	8.33±0.29	2.24±0.2	5.75±0.96	0.43±0.23	2.72±0.19	80.98±2.25	330.55±14.91

(MEAN OF THREE REPLICATES ± SD)

The proximate composition of the fully matured *Dioscorea bulbifera* tubers with critical moisture level of  $61.93 \pm 0.25\%$  is as shown on Table 2. The data indicate that the tubers are high in moisture and carbohydrate but low in protein and fat.

On the basis of the critical moisture content of  $61.93 \pm 0.25\%$  established for the fully matured *Dioscorea bulbifera* in this study, it is posited that data on proximate composition of *Dioscorea bulbifera* in the literature reported along with moisture levels higher than  $61.93 \pm 25\%$  may reflect prematuration levels while those accompanied by moisture level below  $61.93 \pm 0.25\%$  may be indicative of post harvest amounts.

Similarly browning effects reported at activities below the critical value of  $40.50 \pm 0.68$  units established in this study may be associated with prematuration while those at values above the critical value may be linked to post harvest storage conditions.

## CONCLUSION

It has been proposed in this study that a critical moisture level of  $61.93 \pm 0.25\%$  and polyphenol oxidase activity of  $40.50 \pm 0.68$  units per mg protein be used as indices of maturation of *Dioscorea bulbifera* (cultivar: round gunda) tubers. Consequently, 2.31% of protein, 0.15% of fat and 33.11% of carbohydrates (Table 2) are levels consistent with the fully matured *Dioscorea bulbifera* (cultivar: round gunda) and the same cultivar grown under similar environments. Another significance of the critical values of moisture content and polyphenol oxidase activity established in this study is in the fact that they may be used to categorise chemical composition data on tubers found in the literature into post and pre-maturation levels. Since moisture content of tubers can be measured rapidly in an ordinary laboratory, it could form a useful indicator of the age of yam tubers as well as a means of categorising chemical data on tuber composition appropriately.

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