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ASSESSMENT OF PROTEIN AND METABOLITES IN TWO CULTIVARS OF *D.ROTUNDATA SPP.* (YAM) UNDERGOING STORAGE

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ABSTRACT
The levels of protein, total free amino acids, essential and non-essential amino acids were assessed in two cultivars of *D. rotundata spp. elemsu* ***(cvi)*** and *ekunmo* ***(cvii)*** stored in modified yam barn for 16 weeks. The protein levels in ***cvi*** showed significant ($P<0.05$) increase from onset of storage to the peak levels at 8^{th} week, while the significant ($P<0.05$) increase in levels in ***cvii*** which commenced 2^{nd} week of storage peaked at 12^{th} week. There was generally significantly ($P<0.05$) higher levels of protein in ***cvi*** than ***cvii***. The total free amino acid levels decreased significantly ($P<0.05$) in ***cvi*** between $12^{th} – 16^{th}$ week of storage, while no significant ($P>0.05$) increase was observed between $4^{th} – 8^{th}$ week in ***cvi***, and at $4^{th} – 12^{th}$ week in ***cvii***. The essential amino acids; valine showed significantly ($P<0.05$) higher levels in ***cvi*** and leucine in ***cvii***, and significantly ($P<0.05$) low levels of methionine and threonine at the 6^{th} and 14^{th} storage week in both cultivars. Lysine levels significantly ($P<0.05$) increased in ***cvii*** at post-sprouting (14^{th} week). The two cultivars generally showed significantly ($P<0.05$) high levels of non essential amino acids; aspartate and glutamate, and significantly ($P<0.05$) low levels of cysteine. The general insignificant ($P>0.05$) change in levels of these amino acids post-sprouting may however, underline the possibility of their low or non-involvement in metabolic changes leading to sprouting in yam. The significant ($P<0.05$) decrease in glycine levels in ***cvii*** post-sprouting may among other factors, be rationalized for possible utilization in glutathione synthesis. Similarly the increased levels of lysine in ***cvii*** post sprouting may suggest a role for increased membrane integrity in the cultivar, and consequently its enhanced storability over ***cvi***.

KEYWORDS: Pre, Post-sprouting, cultivars elemsu (***cvi***), ekunmo (***cvii***), modified yam barn.

INTRODUCTION

Yam is an important carbohydrate staple in many tropical and subtropical countries principally used as diet, feeds, as well as for production of industrial starch and adhesives (Osagie, 1998).Among the root and tuber crops, yam stands out in terms of protein content (1 – 4%), though its value as a veritable protein source is limited by its bulk (Osagie, 1992). Yam's protein status vary considerably with species and cultivars depending on factors ranging from cultural, climatic to edaphic as well as maturity at harvest, among others (Bell and Favier, 1980). The distribution of the protein in yam tuber similarly varies from the proximal to the distal end, and also depends on cultivar and specie (Mozie, 1984 and Eka, 1985). Incidentally, yam species that have enhanced protein levels are invariably known to be rich in alkaloids (Osagie, 1992).

Low as the protein value of yam is, its role is critical to metabolism. Some form constituents of enzyme systems while others are structural components of yam tissues (Osuji, 1981). The storage proteins in yam are however, rapidly hydrolyzed to their constituent amino acids which are either reutilized in the synthesis of other proteins, or used to provide energy through oxidation of the carbon skeleton, after deamination (Stryer *et a*l, 2002). Considerable protein metabolism and amino acid mobilization have been known to occur during maturation and storage of yam (Osuji, 1981). On the premise that protein and amino acid metabolism constitute the primary cause of biodeteriorative changes capable of inducing membrane damage in stored yam, the present work focuses on the low, but metabolically important protein status of selected cultivar samples using the evolving biochemical changes there from to possibly assess the relative storability of the cultivars.

To achieve this, samples of physiologically mature indigenous cultivars of *Discorea rotundata spp*. in Yagba land, Kogi state, Nigeria, *elemsu*; a cultivar with short storability and *ekunmo*; another with longer storability were harvested and stored in modified yam barn for a period of 16 weeks, during which they were periodically assessed for biochemical parameters possibly associated with biodeteriorative changes during storage.

MATERIALS AND METHODS

Samples of wholesome yam *Dioscorea rotundata* cultivar ***elemsu, cvI*** and cultivar ***ekunmo, cvII*** harvested from farm location in Yagba West LGA, Kogi state, Nigeria were stored in modified yam barn at the prevailing storage temperature ($26\pm5^{o}C$) and relative humidity (70 – 80%) throughout the 16 weeks storage duration. All chemicals used for the various experimental works were of Analytical grade and prepared according to the procedures as described in the various standard methods.

Two tubers each, of ***cvI*** and ***cvII*** samples of similar weights (700 – 1000g) and size, were withdrawn from the modified yam barn at two weeks intervals for given treatments and determinations. The determination of protein contents of stored yam sample was made using the method described by Stroev and Markarova (1989) in a

spectrophotometric method based on chemical interaction between the proteins in the yam sample and biuret reagent. The assessment of the total free amino acid levels in the stored yam sample was made following the spectrophotometric method described by Ikediobi and Oti (1983). These was based on the reaction between ninhydrin and free amino acids in the sample to generate a blue colour compound which absorbed maximally at 420nm and whose intensity was proportional to the total free amino acids content in the sample. The determination of amino acid profile of yam cultivar samples was carried out using the procedure as described by Sparkman *et al*. (1958).

The data obtained from the experimental works were analyzed using statistical package SAS/STAT version 8.1(2000). Analysis of variance was done to determine significant effects among treatments at 5% level and mean separation was by Duncan Multiple Range test (DMRT) to establish statistical difference between the means.

RESULTS AND DISCUSSION

The results obtained were presented as bar chart in Figs 1, 2, 3 & 4. During storage of yam tuber, considerable protein metabolisms do occur and these may encourage biodeteriorative changes (Osuji, 1983). The increase in the levels of protein (Fig. 1) and total free amino acids (Fig. 2) to their peaks during sprouting in ***cvI*** (8^{th} week) and ***cvII*** (12^{th} week) possibly resulted from endogenous synthesis in the tuber, mainly to support sprouting activities. The generally higher protein and amino acid levels in ***cvI*** than ***cvII*** may contribute to the cultivars vulnerability to enhanced proteolytic activities, which may induce biodeterioration and spoilage (Osuji 1981). This may explain why ***cvI*** does not store as long as ***cvII.***

High levels of valine and leucine (Fig 3) asparte and glutamate (Fig 4) may highlight their roles, as ligands for α-amylase (a starch degrading enzyme) activity (Qian *et al.,* 1993). Suffice it to note that the seemingly amplified levels of asprtate and glutamate may partly be attributed to the drastic treatment employed during their analysis leading to oxidation of glutamine and asparagine (Adeyemi, 2009). However, the low levels of methonine, threonine and cysteine in yam may be a reflection of low level of their involvements in metabolism, as well as being the limiting amino acids in yam.

The decrease in glycine levels in ***cvII*** may be associated in part, with its possible utilization as a metabolite for glutathione- a sulfurhydryl buffer's synthesis (Edward *et al.,* 2000). The increased levels of lysine (post-sprouting) may suggest a role for membrane integrity in the stored cultivars resulting from the possible involvement of hydroxylysine in offering of structural reinforcement for epithelial tissues in the stored yam (Wareing and Philip, 1990). This may lend credence to the observed enhanced storability of ***cvII*** than ***cvI***. Generally, the low levels of the sulphur containing amino acids from this work methionine, threonine, cysteine post sprouting corroborate their being as the limiting amino acid in yam (F.A.O 1989).

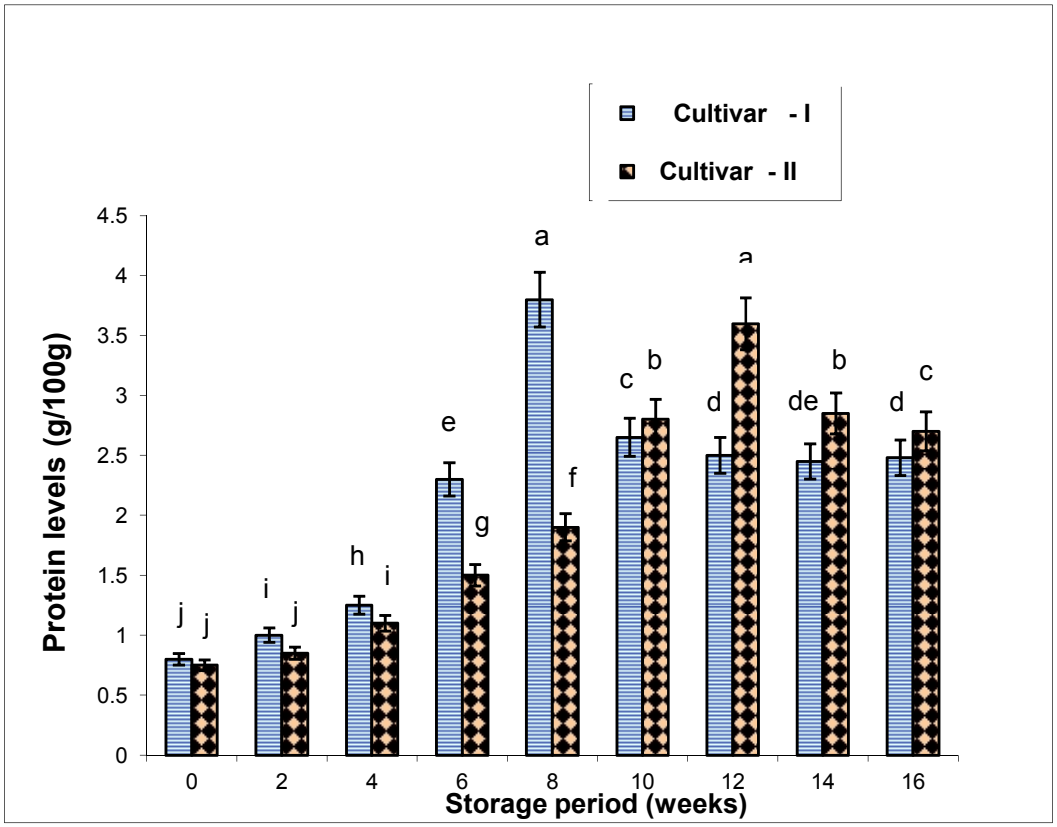

FIGURE 1: Protein levels in two cultivars of *D. rotundata spp*. stored over a period of 16-weeks. Each value represented means ± SEM of three determinations. Bars carrying different alphabets are significantly different ($P < 0.05$).

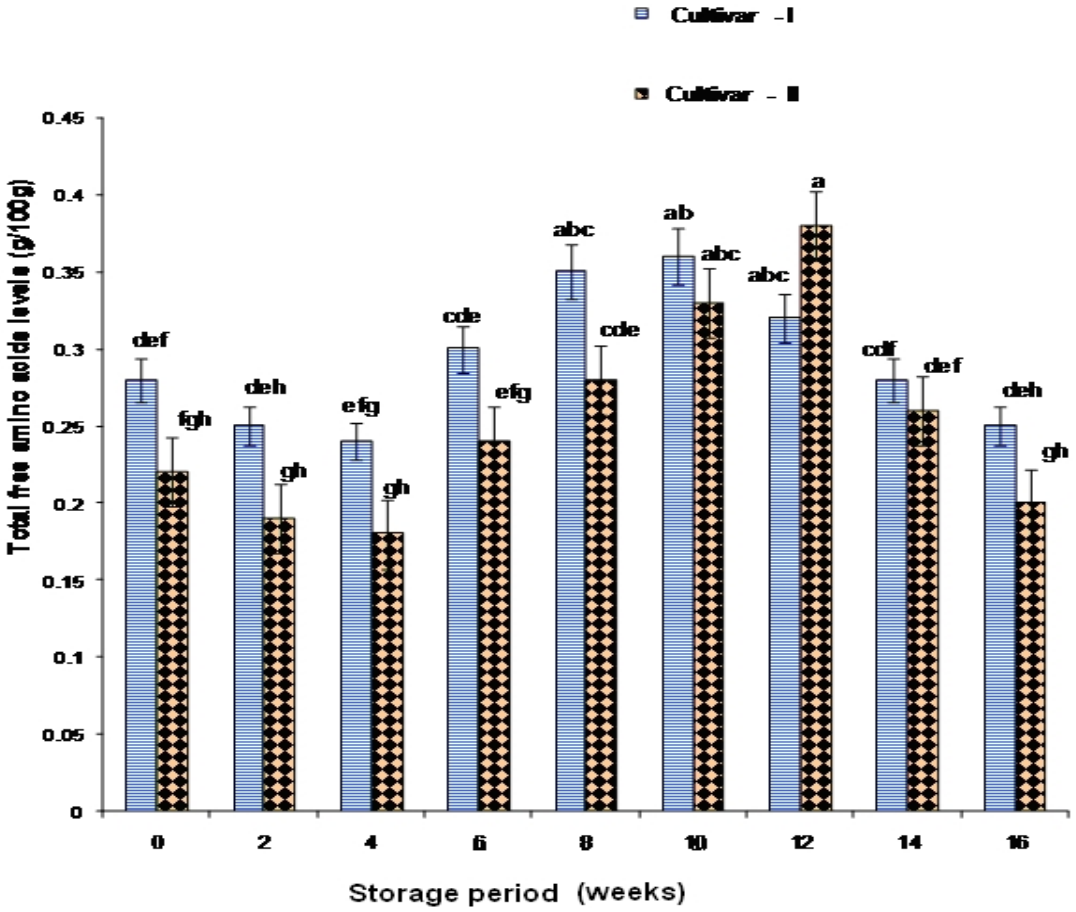

FIGURE 2 Total free amino acids levels in two cultivars of *D. rotundata spp*. stored over a period of 16-weeks. Each value represented means ± SEM of three determinations. Bars carrying different alphabets are significantly different ($P < 0.05$).

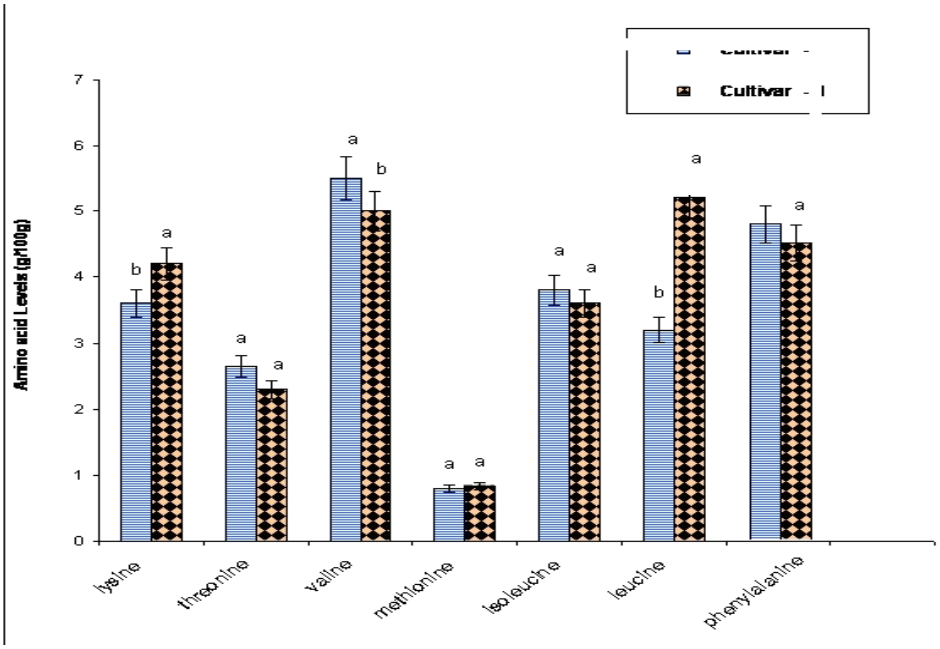

FIGURE 3. Level of some essential amino acids at post-sprouting stage (14th week) in two cultivars of *D. rotundata spp*. stored over a period of 16-weeks.
Each value represented means ± SEM of three determinations. Bars carrying different alphabets are significantly different ($P < 0.05$).

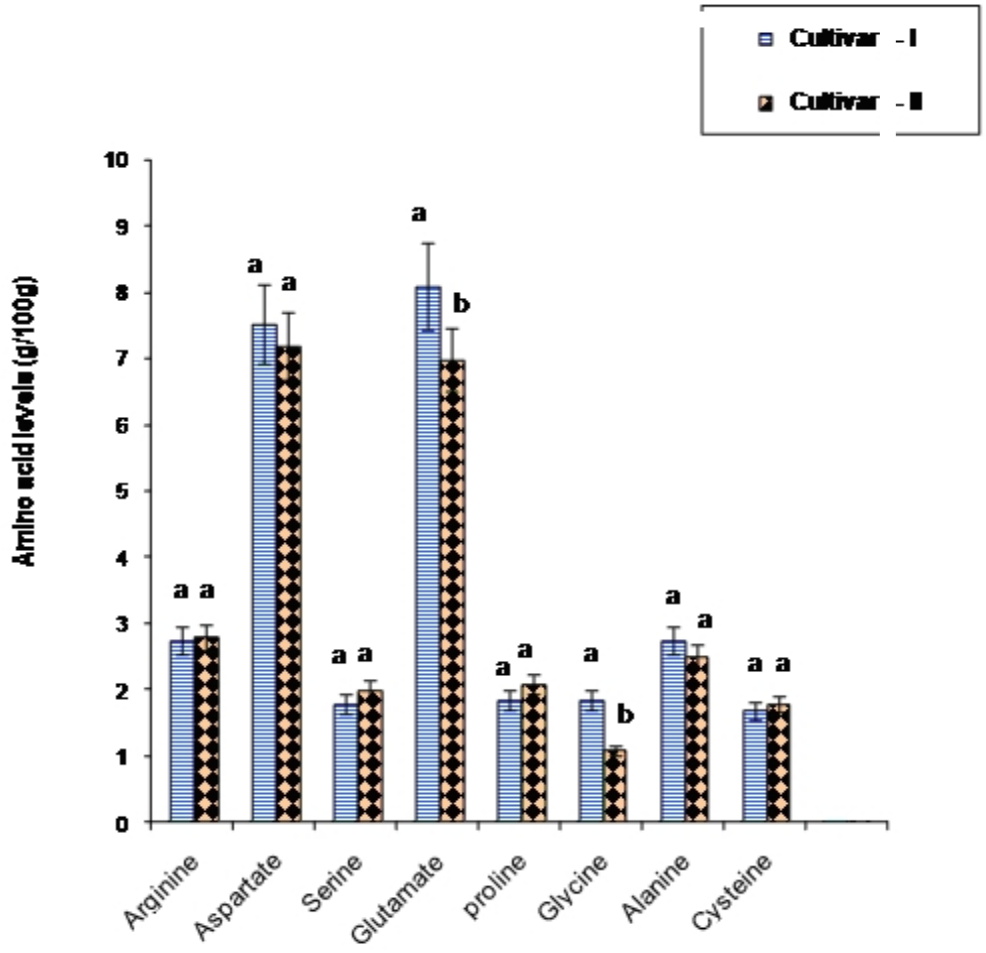

FIGURE 4. Level of some non-essential amino acids at post-sprouting stage (14th week) in two cultivars of *D. rotundata sp*. stored over a period of 16-weeks.
Each value represented means ± SEM of three determinations. Bars carrying different alphabets are significantly different ($P < 0.05$).

CONCLUSION

The overall data obtained from this study lend credence to the comparative storability of the two cultivars ***cvI*** and ***cvII*** as portrayed by the different biochemical indices employed. The lower storability of ***cvI*** may be associated with the cultivars enhanced protein levels among others factors. The enhanced storability in ***cvII*** may be associated with low protein and protein metabolites levels (and consequently low proteolytic activities) coupled with enhanced levels of lysine amino acids which had a role for increased structural integrity of the yam tissue membrane during storage.

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