Sampling variability in cassava roots for total carotene content

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Introduction

As the interest for a precise determination of the provitamin A carotenoids content of foods is becoming more generalized, efforts had to be directed at improving the validity/reliability of the data. Because of the inherent difficulties in carotenoid analysis, which are sometimes not perceived by the analysts themselves, the reliability of a substantial portion of existing data may be questionable.

It is recognized that the carotenoid composition varies as a function of several factors (e.g. stage of maturity, cultivar, handling, analysis method, etc.). However, little is known about the variability of the samples used for measuring carotene content in tissue like cassava (*Manihot Sculenta* Crantz) roots.

The overall objective of this project is to improve the nutritional status of people living in marginal environments of the tropics, by selecting and promoting cassava genotypes with high and good bio-availability of micronutrients and vitamins. This research is part of the HarvestPlus Initiative and was financed by DANIDA and USAID.

Objective

The specific objective was to measure sampling variation for β-carotene in cassava roots for a more uniform, comparable and reliable data.

Materials and methods

Sampling of root tissue. Eleven-months old plants from cultivar CM 2173-7 (light yellow roots type) were harvested at CIAT's Experimental Station in Palmira, Colombia. Two or three commercial size roots were randomly taken from each plant. Each root was peeled and transversally cut into three tissue blocks 3 to 5 cm thick in the proximal, central and distal portions of the root, and each block was divided in three sections (external, intermedite, and internal) to obtain nine measurements per root. Figure 1 illustrates the sampling scheme used for analysis of the variation with respect to total carotenoids between sections of the same root.

Extraction. The carotenoid extraction procedure outlined by Safo-Katanga et al. (1984)[1] was adjusted by extracting root parenchyma with petroleum ether.The adjusted protocol included several extractions with petroleum ether 35-65 ºC to guarantee total extraction of carotenoids compounds. A sample of 5 g raw material was analyzed per sample. Quantification of total carotenes was done by absorption spectrophotometry.

[1] Safo-Katanga, O. et al. 1984. Studies on the content of yellow-pigmed cassava. In: Terry, E.R. et al. (eds). Tropical Roots crops production and Uses in Africa. IDRC, Ottawa, Canada. pp.103-104.

Results

Figure 1 summarizes the results observed in the 279 samples evaluated for carotenoid content. Three roots from nine plants plus two roots from two additional plants (a total of 31 roots) were used in this study.

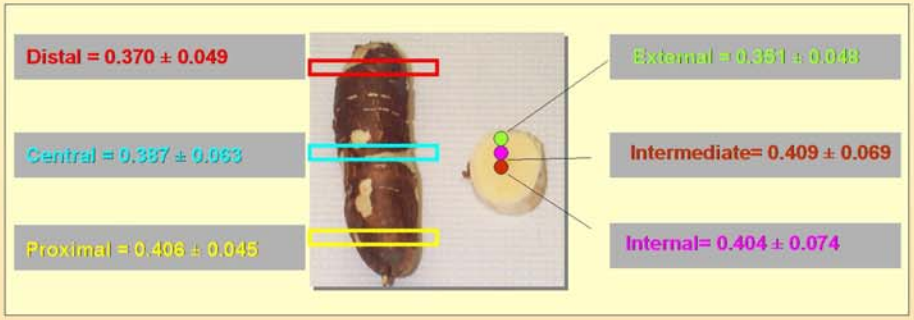

Figure 1. Average and standard deviation for the carotenoid measurements in different section of cassava roots, based on a sample of 31 roots, from 11 different plants of cultviar CM 2173-7. Values in mg / 100 g of fresh tissue.

The overall average for carotene content was 0.355 ± 0.028 mg / 100 g fresh tissue. The range of variation in the average carotenoid content among the 11 plants evaluated was 0.293 to 0.391 mg / 100 g fresh tissue. The average standard deviation among roots within the same plant was 0.034 mg / 100 g fresh tissue.

The highest and lowest individual measurements among the 279 data points were 0.742 and 0.214 mg / 100 g fresh tissue, respectively. This variation involves experimental error in the measurements, plant to plant variation (see the standard error of 0.028, above), root within plant variation (see the standard variation of 0.034 above), and sector variation along the length and radial position of the samples within the roots (Figure 1).

Although no position in the root resulted in a statistically significant difference for carotenoid content, there was a clear trend for the proximal section to have higher carotene contents that the distal section. Also the periphery of the root tended to have lower amounts of carotenoids that the more internal tissue.

Conclusions

To reduce experimental error through differences in sampling procedures, it is recommended that a standard sampling procedure is used for measuring carotene content in cassava roots. A section of the central part of the root, from periphery to center would probably minimize the sampling effect.