Effect of processing on β-carotene content of cassava roots.

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Introduction

Most of the available data on carotenoid contents refer to unprocessed food sources. However, the ultimate effect of those carotenoids in human health depends heavily on the way the foods are processed and consumed by the population. In addition to the original quality and quantity of carotenoids present in cassava, their bio-efficacy will depend on the amount lost upon processing the roots. The effects of processing on bio-availability of carotenes, therefore, needs to be determined. The influence of different preparation or processing methods on -carotene and total carotenoids contents of cassava roots was investigated.
The overall objective of this project was 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.

Objectives

- To determine the effect of different preparation or processing methods on β -carotene and total carotenes content of cassava roots.
- To compare two methodologies of analysis for carotenoid compounds

Methodology

Extraction. Acetone and petroleum ether were used in the extraction of the carotenoids present in the root parenchyma. The adjusted protocol included several extractions with acetone and/or petroleum ether 35-65 ºC to guarantee total extraction of carotenoid compounds . A sample of 5 g was taken from a root, taken at random from 10 to 11 months old plants (unprocessed check) and after processing the roots. The quantification of pro-vitamin A carotenoids was done by absorption spectrophotometry (for total carotenoids) or HPLC (for β-carotene) methodologies.

Quantification of total carotenoids content. Total caroten content was determined by the absorption spectrophotometry method, using a Shimadzu UV-VIS 160A recording spectrophotometer. Detection was done at λ= 450 nm for root extracts.

Quantitation of β-carotene carotene content. Starting from the method used for the spectrophotometric quantification, aliquots (1 ml) of petroleum extract were concentrated by vacuum. Then the concentrated extract was centrifuged at 14000 rpm and filtered by 0.2 μ. 20 μl were injected in the HPLC system using a YMC-C30 column (250 mm, ID:4.6mm, Waters). Separation was done by a linear gradient elution from methanol:methyl-t-butylether:water, to methanol:methyl-t-butylether:water, 20:76:4 v/v during 90 minutes at 1 ml min^{-1} and 23°C. β-carotene, was detected by monitoring absorption at 450 nm. Identification and quantification was done by comparing retention times and uv-vis spectra with commercial standards.

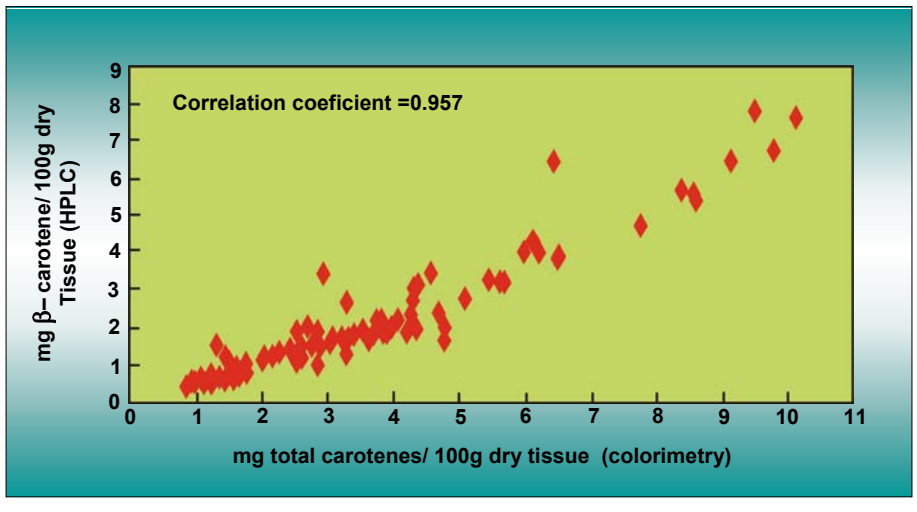

Figure 1. Relationship between carotenes (mg/100 g DT) measured by the colorimetric and HPLC methods (data from 24 samples, measured in four replications).

Results

Carotenoids content were measured by visible absorption spectrophotometry and HPLC on fresh cassava roots, and after root processing by boiling (30 min), sun-drying (76 h), oven-drying (60 °C, 24 h), lyophilization and production of gari (cassava fermented, partially dehydrated and baked) from four cassava varieties (four replications), with good agronomic performance in different agro-ecological zones in Colombia.

Analysis of total carotenoids and β -carotene content

Based on 96 samples, the correlation between the two methods of measurements was excellent (correlation coeficient = 0.957, when calculated based on dry tissue data). The advantage of HPLC is that it allows for the partitioning of total carotenoids into its components (α- and β -carotene, lutein, lycopene, etc).
It was interesting to observe that most carotenoinds extracted from cassava roots was β -carotene. On average, about 60% of carotenoids was β -carotene (ranging from 56 to 64%). This is advantageous because of the recognized bio-efficacy of this type of carotenoid to be metabolized into retinol (the active form of vitamin A).

Figure 2 illustrates the amount of carotenoids lost upon different processing methods. A relatively small amount of β - carotene is lost upon boiling the roots (up to 76% of the original levels was recovered in boiled roots), whereas drying the roots by the common sun–drying process or in the oven, resulted in a recovery of 40 and 60%, respectively. Production of gari resulted in the recovery of only 20% of the original carotenoids found in the unprocessed roots. On average about 75% of carotenes remained after lyophilization. These results agree with those previously reported based on the colorimetric method of quantifying total carotene contents. However, it is important to note that a clone with yellow roots lost little more β -carotene than the one with cream roots after processing. This can indicate a varietal effect on the stability of -carotene after common processing before consumption. Further analyses will be conducted to corroborate these results.

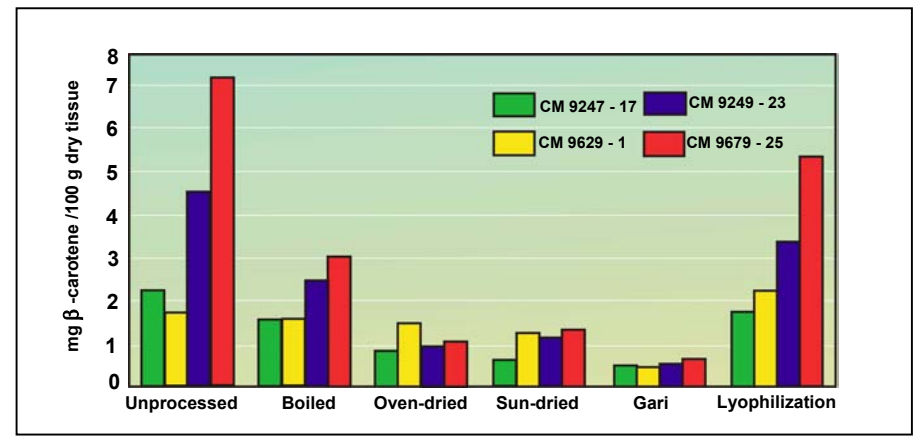

Figure 2. β -carotene content (mg/100 g) adjusted for dry matter content in fresh roots and after different processing methods. Measurements were made using the HPLC methodology.

Conclusions

- Yellow cassava roots are a promising source of the provitamin A carotenoids.
- Retention of β -carotene decreases in the following order: lyophilization, boiling, oven-drying, sun-drying and gari.
- Prolonged processing and cooking upon gari preparation results in substantial loss of β -carotene.

References

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