

Changes in Nutrient Content for β -Carotene, Iron and Zinc in Solar Dried and Stored *Amaranthus cruentus* Vegetables

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Abstract – There is increasing need to store the nutrient rich amaranth leaves which are plenty during the wet season for use in dry season, but there is little information on the micronutrient stability on storage of vegetables produced in dry areas meant to bridge the seasonal gap. The stored dry leaves can be utilized during dry season by mixing them with cereal flours for making porridge for children under five who are vulnerable to micronutrient deficiency. The aim was to assess the changes in nutrient content of solar dried amaranth leaves within nine months of storage at ambient condition for the purpose of bridging the seasonal gap. Amaranth leaves were solar dried and ground into powder and stored for nine months. Regular testing of nutrients retention (β -carotene, iron and zinc) was done after every three months. The content of β - carotene was established using UV-VIS Spectrophotometry method while for iron and zinc analysis atomic absorption spectrophotometry. Results showed that the mean losses of nutrients was 3.7 ± 0.04 , 1.4 ± 0.03 and 0.69 ± 0.04 for β -carotene, iron and zinc which translated to a percentage loss of 9.1%, 2.0% and 2.8%, respectively after nine months storage. The study noted no significant change ($P>0.05$) in the nutritional contents of β -carotene, iron and zinc. The concentration of β -carotene, iron and zinc remained relatively stable as shown by small fluctuations of nutrients. Dried amaranth leaves retain adequate nutrients when stored for nine months and thus can fill the seasonal gap.

Keywords – *Amaranthus cruentus* Leaves, Iron And Solar Drying, Zinc, β -Carotene.

I. INTRODUCTION

The need to dry and store leafy vegetables is important to enhance availability throughout the year due to seasonality gaps. Some factors to consider on storage are to prevent loss of nutrients. Amaranth leaves are rich in micronutrients, but highly perishable and have a short life span after harvesting [1-4]. During the wet season, amaranth leaves which are either cultivated or grow naturally are abundant but without post harvest preservation, the excess after consumption goes to waste. A recommendation by Gupta *et al.* [1], suggests a need to explore appropriate ways that can be adopted by rural communities to preserve the leafy vegetables for use in dry seasons when availability is low. Amaranth can be dried and stored using appropriate technology to ensure availability throughout the year [2].

Drying has been documented as an appropriate method to ensure that the vegetables that are in plenty during the wet seasons are available in other seasons [2]. Though drying leads to loss of a proportion of the water soluble vitamins, fat soluble vitamins like β -carotene are fairly

well-retained [5]. Drying has been found to have no significant effect on iron content in amaranth [6] and zinc content [4,6].

Solar drying is recommended for preservation of green leafy vegetables as it is associated with minimal nutrient losses [7]. During the process of solar drying, the leaves are completely protected against rain, dust, wind, water, insects and animals. It is deemed an economically feasible method for preservation among smallholders. [8] Solar drying of vegetables have been found to have a higher retention of micronutrients and colour than sun drying. [9,8,10,11] A study conducted in Tanzania shows that solar-dried vegetables showed a retention of $> 66\%$ of β -carotene as compared to sun drying [12,10,13,14].

Minimal information exists on stability of dried amaranth leaves on storage. In addition, there are problems in commercialization of amaranth leaves products, mainly because of insufficient data. Thus, the need to determine the nutrient retention in dried amaranth leaves. The aim of this study was to assess the changes in nutrient content of solar dried amaranth leaves with nine months storage.

II. METHODOLOGY

In this study, the amaranth cultivar used was *Amaranthus cruentus*. This cultivar was selected based on its high yield and agronomic desirability [15]. The leaves were obtained from Enkorika area in Kajiado County, Kenya which is an arid area. The area has a high prevalence of vitamin A, iron and zinc deficiency and the situation can be improved by ensuring use of amaranth leaves which are minimal during the lean season. The targeted area had farmers supported by local organizations to produce and market the leaves. Ten farms were randomly selected. The leaves were harvested at the 6th week after germination, in the morning, for optimal nutrients as recommended by Showemimo and Olarewaju [15]. Using the zigzag sampling method, samples were collected from five points in each of the ten farms. The samples were packaged in perforated bags, placed in a cool box and transported to Kenya Industrial Research and Development Institute. The leaves were sorted and washed under cold clean running water. This was followed by blanching in hot water for 3 minutes at 90 °C. [16] The leaves were then cooled by immersing in cold water for 30 seconds. They were strained to remove excess water. The leaves were then spaced on the drying trays without overlapping [16]. Finally the trays were placed into the solar boxes for drying.

Table 1: Micronutrient content (mg/100g) in dried amaranth leaves with storage

(n=3)	Day 1	3 rd month	6 th month	9 th month	Change (%)
β-carotene	40.11 ± 3.21	39.19 ± 3.11	37.23 ± 3.26	36.41 ± 3.08	3.7 (9.2%)
Iron	71.85 ± 3.93	71.34 ± 3.46	71.02 ± 3.41	70.25 ± 3.26	1.4 (2.0%)
Zinc	27.28 ± 1.43	26.93 ± 1.28	26.73 ± 1.56	26.59 ± 1.22	0.69 (2.5%)

Drying was done until a moisture content of 6% was attained as recommended by Kordylas [17]. Milling was done using 0.65 mm mesh. They were then packaged in packs of 50 g in sealed polythene bags to ensure no moisture absorption and transported to the laboratory for analysis.

Solar dryers were used as they provide a faster drying rate and keeping off insects. Fast drying improves quality of the product. Though fast drying is beneficial, care was taken to avoid over-drying as this may cause degradation. The dried leaves were stored in air tight containers for nine months at room temperature (22°– 26 ° C) at Kenya Industrial Research and Development Institute. Determination of nutrient content for β-carotene was analyzed by use of UV-VIS Spectrophotometry, while iron and zinc using Absorption Spectrophotometry. All chemical analyses were done in triplicate. Paired t-test was used to test for significance difference between the nutrient content at the start and after nine months.

III. RESULTS DISCUSSION

The content of β-carotene, iron and zinc in the dried leaves on monthly basis is as shown in Table 1. The mean change in nutrient content was 3.7±0.04, 1.4±0.03 and 0.69±0.04 for β-carotene, iron and zinc, respectively. These losses translated to a percentage loss of 9.1%, 2.0% and 2.8% for β-carotene, iron and zinc, respectively. From the results, there was a slight change in the nutrient content at the ninth month for β-carotene, iron and zinc which were not significant (P>0.05) (Table 2). This is in agreement with results from other studies that showed no significant decrease in these nutrients with storage [3,4,7]. Despite these minimal losses, the retained β-carotene, iron and zinc were adequate as a source of micronutrients.

Table 2: Change in micronutrient content (mg/100g) from baseline to nine months

(n=3)	Baseline	9 th month	t-test (p value)
β-carotene	40.11± 3.21	36.41± 3.08	0.057
Iron	71.85± 3.93	70.25± 3.26	0.065
Zinc	27.28± 1.43	26.59± 1.22	0.062

IV. CONCLUSION

Drying amaranth leaves and storage in air tight containers at room temperature was sufficient to enhance stability of dried amaranth leaves for nine months without any significant change in the nutritional contents for β-carotene, iron and zinc. Thus, dried amaranth leaves can fill the seasonal gap. The stability of the micronutrient is a key factor toward the success of food storage.

This study provides an understanding on the selection of drying method, storage stability and adequate retention of micronutrient in the stored dry amaranth leaves.

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