REDUCING VITAMIN A DEFICIENCY THROUGH INTRODUCTION OF ORANGE-FLESHED SWEETPOTATOES IN WESTERN KENYA[ϕ].

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Abstract

A study was conducted to assess the potential for improvement of the vitamin A status of people in western Kenya through the dissemination and promotion of orange-fleshed sweetpotato varieties. Highly yielding orange-fleshed sweetpotato varieties were given to members of 20 women's groups from two divisions in South Nyanza Province of western Kenya, and members were educated about vitamin A. Half of the groups were trained in methods of sweetpotato processing and utilisation. Changes in vitamin A consumption patterns among children were evaluated using the HKI food frequency method. Pre-intervention baseline assessment from 15 communities in which the women's groups were located showed that vitamin A consumption was quite low, with an average HKI score of 4.0, well below the cut off of 6.0. Results of this assessment suggested that orange-fleshed sweetpotatoes would be an inexpensive source of dietary vitamin A that could be produced year-round. Of all the available plant sources of vitamin A, orange-fleshed sweetpotatoes would also be the best source of calories. Post-intervention HKI scores, earnings from sales of orange-fleshed sweetpotatoes and other income variables were compared for the women's groups. Groups that had received intervention components including processing and sweetpotato utilization had significantly higher HKI scores, and a better knowledge of food sources of vitamin A than groups that did not receive training. Our results suggest that introduction of orange-fleshed sweetpotato varieties along with training on processing, marketing and nutrition could significantly contribute to alleviation of vitamin A deficiency in parts of Africa where sweetpotato is grown.

Introduction

Vitamin A deficiency is a serious nutritional problem in many developing countries and is widespread in Kenya. Extremely low serum retinol levels are found in the arid and semi-arid northeast, along the coast and throughout densely populated western Kenya (Government of Kenya and UNICEF, 1995). Since the early 1990s, the main strategy for combating vitamin A deficiency by public health programs has been to distribute capsules containing massive

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doses of vitamin A (Kennedy and Oniango, 1993). These programs are costly and, in Kenya, depend on capsule donations from UNICEF. An alternative to vitamin A capsule distribution would be the increased consumption of β–carotene- and vitamin A-rich foodstuffs. Rahmathullah et al. (1990) suggested this as a safer and more appropriate long-term approach to controlling vitamin A deficiency. Foods such as dairy and meat products containing pre-formed vitamin A are too expensive for the many of the people most at risk of vitamin A deficiency in Western Kenya. However, inexpensive plant foods high in pro-vitamin A carotenoids should be able to make a significant contribution to improved human health. The challenge is to increase their availability, utilisation and consumer acceptance.

Storage roots of orange-fleshed sweetpotato (*Ipomoea batatas)* are a major food source of carotenoids, along with apricot, carrot, and peach (Henkel, 1996; Woolfe, 1992). The orange color intensity of sweetpotato storage roots varies from one cultivar to another, ranging from deep orange through yellow to white. The intensity of the orange color of storage root flesh is highly correlated with carotenoid content (Ameny and Wilson, 1997). Orange-fleshed sweetpotato storage roots contain principally β–carotene, the most active of the pro-vitamin A carotenoids (Purcell, 1962; Purcell and Walter, 1968; Simonne et al., 1993; Takahata et al., 1993; Simon, 1997).

Sweetpotato is an import food security crop in much of eastern and southern Africa. where it is prized by farmers for its low input requirements and ability to provide reliably good yield, even under marginal conditions (Ewell, 1990). It is consumed by all age groups, but is particularly liked by young children, the group most vulnerable to the vitamin A deficiency. It is often considered to be a "woman's crop". Most varieties currently consumed in Sub-Saharan Africa have white or pale yellow flesh color, and contain very little β–carotene (Takahata et al.,1993; Ameny and Wilson, 1997). However, high yielding, orange-fleshed sweetpotato varieties containing high levels of carotenoids are available in this region (Gichuki et al., 1997).

Main goal

- To determine whether β–carotene rich sweetpotato cultivars can provide a year-round, sustainable source of vitamin A in the diets of communities in western Kenya where very low levels of vitamin A consumption among children under five years of age have been identified.

Specific objectives

- To introduce and evaluate β–carotene-rich sweetpotato cultivars to women's groups in the South Nyanza region;
- To educate communities on the role of vitamin A in the diet for both children and adults through working directly with women's groups, mobilizing public health workers, and utilizing the mass media;
- To collaborate closely with women's groups in developing sweetpotato-based infant weaning foods high in β–carotene, and in producing and marketing processed sweetpotato products for income-generation;

- To increase the capacity for the women's groups to monitor and evaluate the varietal suitability and processed product feasibility.

The intervention strategy

- Introduction of high β–carotene sweetpotato varieties to women's groups,
- Nutrition education to ensure that women had a role in defining the intervention for sustainability of the activities,
- Promotion of sweetpotato processing to optimize pro-vitamin A carotenoid retention,
- Mass distribution of selected orange-fleshed sweetpotato cultivars.

The conceptual framework of the study is shown in Figure 1. A two-tiered approach was adopted. Intensive intervention with selected number of women's groups in both Ndhiwa and Rongo has been the principal mean for testing educational materials, new sweetpotato cultivars, and exploring the potential for income-generating activities. Twenty women's groups received sweetpotato cultivars to test in group-managed trials. Groups were most closely matched based on their mean HKI scores and mean distance to the nearest market. Intervention groups received nutritional education messages and worked with village-based extension agents to decide how best to use their new sweetpotatoes.

Results and discussion

Performance of new sweetpotato cultivars.

- Table 1 (from Gichuki et al.,1997) shows the mean performance and the main characteristics of four newly introduced cultivars compared to the local check variety in on-farm trials in Ndhiwa and Rongo. Simama consistently had the highest total yields of fresh storage roots. In almost all cases Pumpkin and Japanese had above average yields. Kakamega 4 had an average but stable yield and performed better than the local check. On average the local checks had the lowest yields. The mean performance of clones across all sites in Ndhiwa and Rongo for each season had a similar trend for storage root yields.
- The general evaluation for agronomic characteristics of cultivars by both farmers and researchers rated Simama as the highest. Farmers gave the local checks a low score compared to the newly introduced cultivars, which might be an indication of the value farmers attach to new sweetpotato varieties. There was a low level of damage by diseases and pests at most sites, but the difference was not significant among cultivars.
- Considering the performance across seasons and sites, the varieties Simama, Pumpkin, Japanese, and Kakamega 4 were found to be agronomically suitable for production in Rongo and Ndhiwa. Farmers stated that they based their evaluation on high yield, good foliage cover and resistance to weevil damage.

Acceptability.

- Taste tests conducted with the women's groups also indicated that Simama, Pumpkin, Kakamega 4 and Japanese were acceptable to local consumers. Overall mean scores were higher in Rongo than those in Ndhiwa. In Rongo, the taste of Simama and Pumpkin was preferred over that of Kakamega 4 and Japanese. In contrast, in Ndhiwa, the taste of Kakamega 4 and Simama was preferred over Pumpkin and Japanese. At both locations Simama was preferred to Japanese. Kakamega 4 ranked highest in terms of cooked appearance with Pumpkin and Simama having consistently high appearance ratings as well. Mean acceptability of local check clones for taste and appearance was high at both sites.

Chemical characteristics of newly introduced cultivars.

- Simama, Kakamega 4 had *dry matter* content above 27%. This concurs with the eating preferences of the community who prefer high dry matter sweetpotato varieties. Pumpkin and Japanese had relatively low dry matter contents resulting in a mushy texture, less preferred by East African adult consumers but very much liked by children.
- Pumpkin and Japanese had the highest ß-carotene contents, close to that of carrots sold on Nairobi markets (result not shown).
- Kakamega 4 had adequate levels of ß-carotene (>100 µg retinol equivalent/ 100 g of fresh root) to be considered a good source of vitamin A.
- In spite of its high yield and the yellow-fleshed colour, level of ß-carotene was low to very low for Simama roots. It was initially thought that a yellow-fleshed variety might make a contribution to vitamin A nutrition.
- The yellow- and white-fleshed local checks which were evaluated had very low levels of ß-carotene.
- The flesh color of the high ß-carotene varieties was orange while the ß-carotene content was low to very low in yellow- and white-fleshed varieties.
- *Processed sweetpotato products.* Figure 2 (from Hagenimana et al., 1997) shows that the incorporation of orange-fleshed sweetpotato roots significantly increased the total carotenoid contents of the products over those containing no sweetpotato, and improve the color of the products, giving them an attractive egg-like appearance.

Results from the surveys.

- Vitamin A deficiency is a major problem in Ndhiwa division. None of the 15 communities surveyed exceeded the 6.0 cut-off point for community level vitamin A deficiency using the Total Weighted Index, whose overall mean was only 4.0 days per week. The mean for frequency of consumption of animal sources was only 3.0 for the entire sample.
- While a diversity of plant and animal sources of vitamin A are available, cheaper plant sources which can easily be grown within the homestead are not being fully exploited and most animal sources must be purchased and are frequently beyond the means of poorer households. Strategy of nutrition and health education in combination with the introduction and promotion of orange-fleshed sweetpotato varieties was required.
- Three sources of vitamin A which most households could produce year-round were: sweetpotatoes, dark green leaves, and papaya. However, note should be taken that the pro-vitamin A in some leafy vegetables may have low availability (de Pee et al., 1995), and hence, are less desirable as sources of vitamin A than sweetpotatoes, which are known for their high bioavailability (Tsou, 1994).
- Figure 3 shows HKI scores of the pre- and post-intervention activities. Pre-intervention results indicated that the scores were similar among intervention and control groups in Rongo and Ndhiwa. However, Ndhiwa had low HKI scores of 4.8 for the intervention women's groups and 4.6 for the control groups; and Rongo had higher scores of 8.9 and 8.0 for intervention and control women's groups respectively. These results indicated that the practice of consuming vitamin A foods was similar for intervention and control groups and that communities in Rongo had a high level of vitamin A consumption.
- Post-intervention data indicated a similar pattern but with a better positive change among the intervention groups both in Ndhiwa and Rongo. In Rongo, a -0.5 was observed among the intervention groups but still they were above the cutoff point of 6.0. This negative

change was probably due to an unusual long drought experienced in Rongo during the post-intervention survey. There was a big change of -3.7 in the control groups indicating that the intervention groups were able to cushion the drought effects probably through the intervention tools applied.

- Knowledge related to the poor sources of vitamin A had tremendously increased in groups receiving project intervention package.

Conclusion

- Orange-fleshed sweetpotato cultivars were successfully accepted by the communities of Rongo and Ndhiwa through the women's groups and their increased consumption in either fresh or processed form can be an important factor in reducing dietary deficiency of vitamin A;
- To efficiently combat vitamin A deficiency through the use of orange-fleshed sweetpotato, provision of sweetpotato planting material should be accompanied by processing, utilization and marketing of the crop, and improvement of the knowledge on vitamin A for the women's groups.

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Table 1. Mean performance of newly introduced sweetpotato cultivars in project area*

Cultivar	Origin	Flesh color	Yield (T/Ha)	Dry Matter (T/Ha)	β–carotene (mg/100g fresh root)	Taste Rating**
Simama (Kemb 10)	Kenya	Yellow	14.30	4.65	0.33	3.90
Kakamega 4 (SPK 004)	Kenya	Orange	9.50	2.88	3.44	3.70
Pumpkin (CIP 420027)	Peru	Orange	10.30	2.11	4.10	3.50
Japanese (CIP 420009)	Peru	Orange	9.90	2.38	4.49	3.50
Local check	Kenya	Yellow	3.70	1.28	0.16	3.70

* From Gichuki et al. (1997).
**Hedonic scale was 1-5 where 1 was very bad and 5 very good.

Figure 1. Conceptual Framework

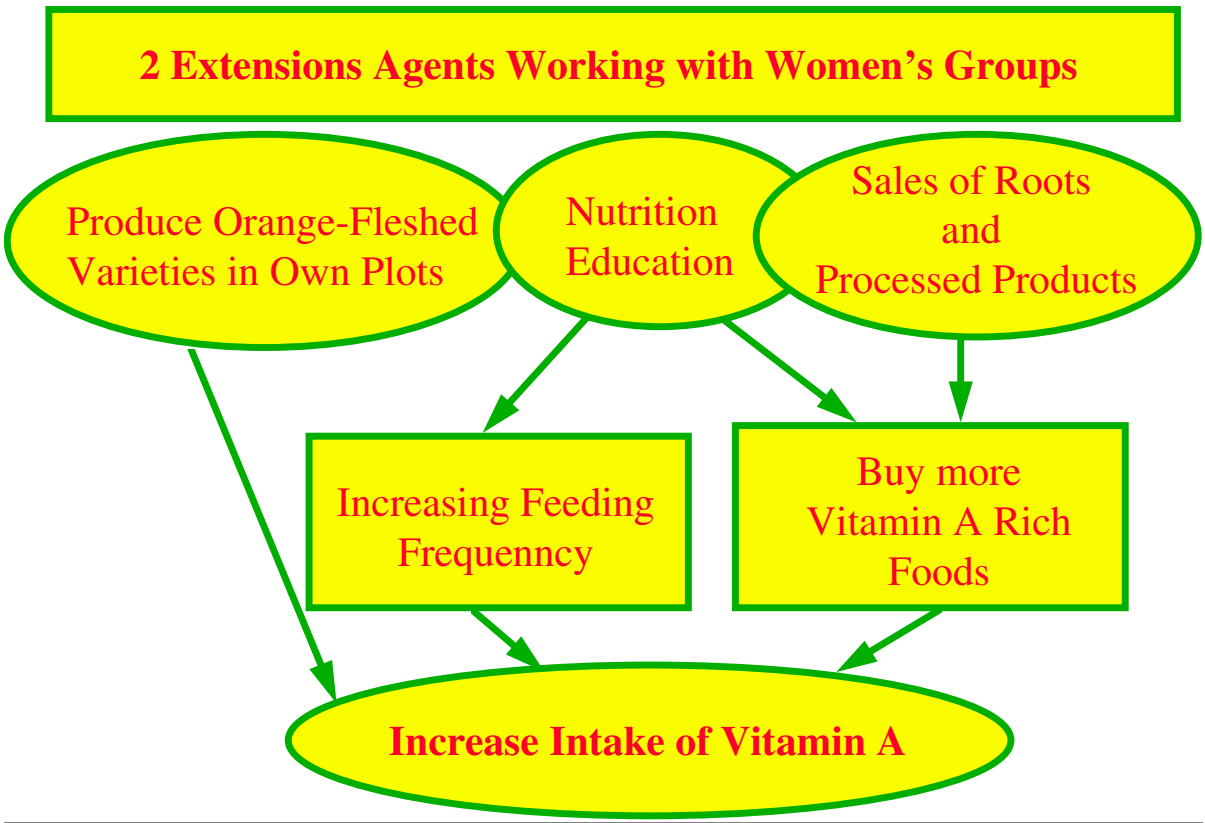
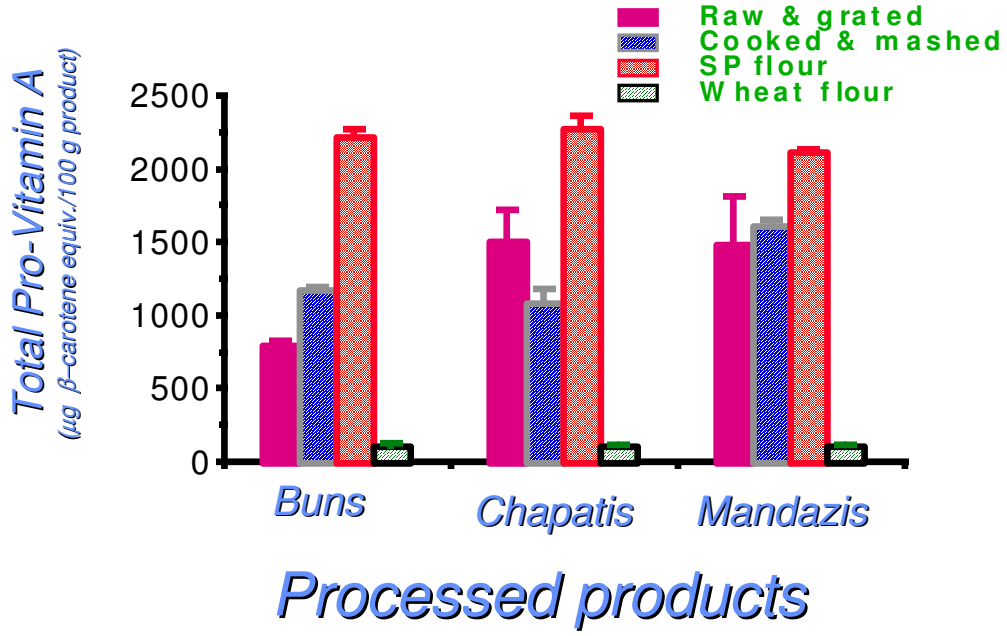


Figure 2. Improvement of Pro-Vitamin A in Foods by incorporation of sweetpotato, Pumpkin Cultivar (CIP420027)



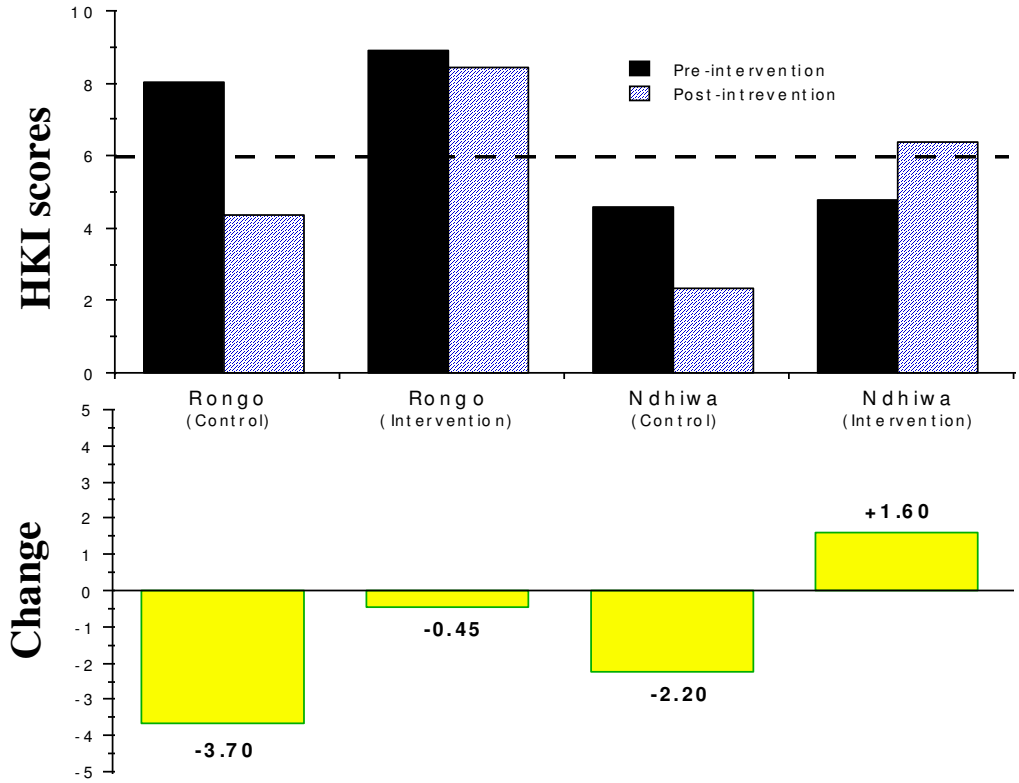


Figure 3. Pre- and post- intervention HKI scores (Use of orange-fleshed sweetpotatoes by women's groups in combating against Vitamin A deficiency).