STUDIES ON INDIGENOUS GREEN LEAFY VEGETABLES OF WESTERN INDIA: CHEMICAL ANALYSIS FOR SELECTED NUTRIENTS, ANTINUTRIENTS, RETENTION AND BIOAVAILABILITY OF β-CAROTENE ON PROCESSING

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SUBMITTED BY

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SUMMARY

This study was initiated to generate a database, so as to facilitate food-based approach to combat vitamin A deficiency. The chief objectives of the study were a) to develop an inventory and seasonal calendar of β-carotene rich foods of the Western Indian state of Gujarat through qualitative research methodologies; b) to estimate the β-carotene content of selected seventeen GLVs by HPLC; c) to estimate other nutrients such as iron, calcium, phosphorous, ascorbic acid and the antinutrient oxalic acid using standard procedures; d) to assess the bioavailability of fresh and dehydrated drumstick leaves and compare it with that of synthetic vitamin A in vitamin A depleted rats; and e) to develop three products involving three different cooking methods, namely, dhebra (shallow-fried), muthia (steamed and sautéed) and handwa (fermented and baked) incorporating fresh radish leaves and test their sensory qualities as well as the retention of β-carotene at the point of consumption.

The Gujarat region of Western India had a wide array of carotene rich plant foods amounting to forty-one. Out of these thirty-seven were GLVs, which included common ones like spinach (*Spinacia oleracea*), radish leaves (*Raphanus sativus*) and fenugreek leaves (*Trigonella foenum graecum*) and uncommon ones like kuba (*Leucas aspera*), dodi (*Pergularia daemia*) and poi leaves (*Basella rubra*). The β-carotene content and other chemical analysis, of many of these GLVs was not listed in the food composition tables of India.

Of these 37 GLVs, 17 were selected for analysis of β-carotene, other nutrients and oxalic acid, on the basis of availability and frequency of consumption.

The β-carotene estimations revealed that out of the seventeen GLVs analyzed, drumstick leaves had the highest β-carotene content with a value of
19,210 μg/100g fresh leaves. β-carotene as a percent of total carotene in drumstick leaves was 47.8%. Twelve of the seventeen leaves analyzed showed a β-carotene content > 3000 μg/100g fresh weight indicating and emphasizing their role as rich sources of β-carotene. In these the β-carotene as percent total carotene ranged from 8.2 to 93.6% indicating the presence of other carotenoid pigments.

The results of chemical analysis revealed that the iron content of the leaves varied from 0.2-0.2.2 mg/g dry weight. Calcium and phosphorous values were between 2.2-42 mg and 2-12 mg/g dry weight respectively. Forty-five percent of the leaves had a desirable Ca: P ratio of 2: 1. The ascorbic acid content of these leaves ranged from 2 - 11.4 mg/g dry weight. Oxalic acid content of the GLVs ranged from 10 to 64 mg/g DW with the exception of kanjero (108 mg/g DW). Thus based on the calcium: oxalic acid ratio (2: 1), of the seventeen, only five GLVs, namely drumstick leaves, fenugreek leaves, onion stalks, radish leaves and the uncommon kuba leaves could be ranked very good for consumption.

The results of the bioavailability trials revealed that, marked clinical signs of vitamin A deficiency, reduced food intake, weight loss, low serum vitamin A (19.1 μg/dl) and low hepatic vitamin A (2.0 μg/g liver) was observed in rats after 4 week of vitamin A deficient diet. Compared to these, the control rats gained weight and had adequate serum (38.4 μg/dl) and hepatic vitamin A (7.1 μg/g liver).

Repletion with either synthetic vitamin A (34.7 μg/dl) or drumstick leaves in fresh (25.8 μg/dl) as well as dehydrated form (28.2 μg/dl), brought about significant improvement in the serum vitamin A levels as well as the clinical signs of vitamin A deficiency, body weight and food intake of the vitamin A repleted rats. The liver retinol values showed a significant improvement in all the three repleted groups as compared to the vitamin A depleted groups (2.0 vs 5.5; 4.8
and 6.0 μg/g liver). The results indicate the great potential of dehydrated drumstick leaves to be used for elimination of vitamin A deficiency.

The sensory evaluation and chemical analysis revealed that on the basis of the amount of leaves that could be incorporated, acceptability characteristics and percent retention of β-carotene, dhebra ranked first with 82% retention of β-carotene followed by muthia with 68% and handwa with only 36% retention of β-carotene. Developing innovative recipes such as dhebra and muthia using leafy vegetables can bring about control of VAD through dietary diversification, which retain more than 50% of the β-carotene.

The results of these studies indicate that food-based strategy of vitamin A deficiency, especially the inclusion of easily accessible, inexpensive β-carotene rich plant foods, namely the GLVs in the everyday diet will go a long way in alleviating the micronutrient deficiency among the vulnerable groups. Administering adequate amounts of GLVs in supplementary feeding programs, can be an alternative approach for alleviation of vitamin A deficiency in the long run, which can also gradually phase out the massive dose prophylaxis,