

## **NUTRITIONAL POTENTIAL OF DRUMSTICK LEAVES: AN INDIAN PERSPECTIVE**

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In today's world, a double burden of malnutrition is the concern of the nutritionists, as we see under nutrition as well as over nutrition on the rise in both the developed as well as the developing countries. Both macro as well as micronutrient deficiencies hinder the national economic development as well as the development of individual human potential. Children are frequently the victims of micronutrient deficiencies and failure to overcome micronutrient malnutrition in a sustainable fashion jeopardizes a nation's future.

Amongst the malnutrition in children, the most significant ones are the deficiencies of Vitamin A (VAD), iron, calcium and folic acid. These nutrient deficiencies are generally referred to as the "diseases of poverty in the midst of plenty". Especially, in a bio-diverse country, like India, where, there are plenty of plant foods available at low-cost but are underutilized. Therefore, identification of locally available, cheap and nutritious foods is the call of the hour. This alone is the logical and sustainable strategy to avoid both nutritional deficiencies as well as diseases due to macro-nutrient excess.

To bring about dietary modification, it is important to both improve the availability of plant foods. Various approaches have been suggested, these include a) Nutrition education for communication to improve practices related to consumption of available plant foods, often using a social marketing approach. b) Horticultural interventions. c) Economic/food policies affecting availability, price and effective demand of nutritious plant foods. d) Technological advances concerning food preservation, plant breeding, etc.

Out of these the food-based strategies :

- are preventive, cost-effective, sustainable and income generating;
- are culturally acceptable and feasible to implement;
- promote self-reliance and community participation;
- take into account the crucial role of breastfeeding and the special needs of infants during the critical weaning period;

- foster the development of environmentally sound food production systems; and
- build alliances among government, consumer groups, the food industry and other relevant organizations to achieve the shared goal of preventing micronutrient malnutrition.

Nutrition education should be a component of food based strategies. Adoption of food-based strategies can make possible redirection of funds previously devoted to curative health care and social welfare to other developmental activities.

One such potential candidate for combating both micro as well as macro-nutrient malnutrition is the Moringa leaves (drumstick leaves). Our earlier studies have reported the significance of drumstick leaves as a source of vitamin A (Nambiar and Seshadri. 1998 and 2001, Seshadri and Nambiar. 2003, Nambiar et al. 2003). These leaves could retain 50% of their  $\beta$ -carotene on shade dehydration and the dehydrated leaves could be easily rehydrated and incorporated into traditional Western Indian recipes without altering their acceptability characteristics (Seshadri et al 1997).

Drumstick leaves (*Moringa oleifera*), with a total carotene of 40,000  $\mu$ g/100 g fresh weight and  $\beta$ -carotene 19,000  $\mu$ g/100 g fresh weight can be a suitable protocol for dietary diversification/improvement strategy. These GLVs with their storehouse of polyphenols as well as calcium, iron, folic acid, riboflavin, vitamin C and beta-carotene, should be used in abundance in order to maintain the body against oxidative damage caused by everyday pollutants.

The Moringa or Drumstick tree (aka Munaga, Muruggai, Muranka) is perennial, erect, slender, medium-sized with many arching branches. It has drumstick-like fruits, small white flowers and small and tear-drop shaped round leaves, which are cooked and eaten as vegetable. There are a number of preparations made from Moringa trees and exported from India, namely fresh drumstick fruit, Drumstick powder, Moringa oil, Moringa seed, Moringa leaf powder, Moringa leaf, Moringa pickle, Moringa tea powder, Moringa fruit powder, Moringa seed kernel, Moringa cake powder and Moringa root and many more. In Southern parts of India, Moringa leaves are used to prepare a pulse preparation called sambar. Drumstick is also preserved and exported worldwide. Tender drumstick leaves, finely chopped, make an excellent garnish for any vegetable dishes, dals, sambars, salads, etc.

Drumstick leaves are also rich sources of flavonols such as kaempferol and 3'-OMe quercetin. A flavone, acacetin and a glycoflavone 4-OMe Vitexin was also identified. The phenolic acids identified included melilotic acid, p-coumaric acid, and vanillic acid (Nambiar et al, 2005). Quercetin is actually the molecular backbone for the citrus bioflavonoids rutin, quercetin and hesperidin. Quercetin has also been found to inhibit the growth of human prostate cancer cells and human breast cancer cells. Quercetin has antiviral activity against several types of viruses. Our results revealed that maximum polyphenols were identified in the drumstick leaves, which further enhances its role as an important functional food.

Nutritionists are now trying to encourage cultivation and incorporation of GLVs in various recipes with minimum effort and little cost, yielding a great benefit. Devising several simple and acceptable  $\beta$ -carotene rich recipes containing GLVs would not only bring variety to the diet and but also help in combating vitamin A deficiency along with other micronutrient deficiencies.

Several gaps of knowledge with respect to the stability of  $\beta$ -carotene from foods and therefore its bioavailability exist. Studies on the retention of total and beta carotene of drumstick leaves on pressure cooking with selected bioactive compounds namely oil (5g), ascorbic acid (25 mg), tomatoes (10g) and polyphenols (~1.5g); indicated that the oil had a maximum positive impact (76-99% retention of BC).

It is generally considered that there is sufficient documentation to conclude that food based approaches using provitamin A sources, when adequately implemented, are effective in the control of vitamin A deficiency, and contribute to alleviating the other usual accompanying nutritional deficits. Other studies have shown that beta carotene from foods may have only limited availability as compared to isolated beta carotene in animal models. Bioavailability trials using fresh as well as blanched and sulphited shade dehydrated drumstick leaves were conducted on vitamin A deficient rats. Male *Charles foster* strain of rats were fed on a synthetic vitamin A deficient diet for 4 weeks and thereafter repleted with 4000 IU vitamin A/kg diet from either fresh or dehydrated drumstick leaves or synthetic vitamin A acetate for the following 4 weeks. These were compared with a control group of rats fed on a basal diet adequate in vitamin A for 8 weeks. The diets were iso-caloric and iso-nitrogenous. The parameters tested were: body weights, food intake, clinical signs and symptom, organ weights, serum and liver retinol levels. The results revealed that the dehydrated drumstick leaves produced a marked increase in food intake, weight gain and liver vitamin A, compared to fresh drumstick leaves or synthetic vitamin A. In the developing countries like India, sources of vitamin A such as drumstick leaves are valuable in overcoming the problem of vitamin A deficiency. These findings also accentuate the importance of carotene on the vitamin A status, and underscore its equivalence to synthetic vitamin A when fed in the right amount (Nambiar and Seshadri 2001).

Diet surveys in India clearly indicate that diets, particularly of the preschool children suffer from several deficiencies of which vitamin A is an important one. Studies on diets of young children indicate that the caregivers make no specific attempts to include GLVs in the diets of their children. There are very few studies that have looked into the acceptability of recipes modified with different GLVs and assessed their impact on very young children, although there is no dearth of recipes per say.

Supplementary Feeding Program (SFP) of the Integrated Child Development Scheme of India, aims at the improvement in the nutritional status of the preschool children and is an ideal platform to introduce DDL into the diets of this target group as a nutritional intervention. This program reaches the doorsteps of the underprivileged community groups by the virtue of several service oriented Non Governmental Organisations (NGOs) who are chiefly involved in the preparation of the supplementary food. An

attempt was made to use the Health Systems Research (HSR) to assess the effectiveness of training and education among the health functionaries along with a nutritional intervention.

We tried to assess the feasibility and acceptability of incorporating the dehydrated drumstick leaves (DDL) into the four salty recipes of the SFP with the support of the ICDS and NGO staff, on the preschool children (1-5 y) along with nutrition communication on their knowledge, attitude and practice (KAP). An integrated approach was adapted in this study which included comprehensive training sessions for the staff of the ICDS and Non-government organization (NGO) involved in the SF preparations. Prior to the acceptability trials, data were elicited on the socio-economic profile and knowledge about vitamin A, from 60 children of 1-5 year of age attending two anganwadi centres of the ICDS. From these, 40 children attending one anganwadi were supplemented with pre-tested DDL incorporated recipes (5-7 g DDI/100 g product) along with NC for one month. Spot observations and organoleptic evaluation results indicated high compliance of the DDL-recipes by the children. The results also indicated that the recipes were highly acceptable to the ICDS authorities as well as the NGO staff. The pilot study indicated that integration of NC along with the introduction of unconventional DDL, into the ICDS-SF, was feasible and can be endeavoured for a longer duration in the existing national programmes.

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