



# MANAGEMENT OF MICRONUTRIENT DEFICIENCIES IN ADOLESCENT GIRLS : AN INTERVENTIONAL APPROACH

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## Abstract

Throughout the history of human civilization, plants and their by-products have been major sources of medicine. Medicinal knowledge of numerous plant species has made an outstanding contribution in the origin and evaluation of many traditional herbal systems of medicine. Iron requirement peaks during adolescence due to rapid growth with sharp increase in lean body mass, body volume and red cell mass which increase iron needs for myoglobin in muscles and hemoglobin in blood. Micronutrient malnutrition especially of iron, calcium, and vitamin C is recognized as an important public health problem affecting more than 2 billion people. Turnip greens are dark-green leafy tops of turnip plant the botanical name of turnip greens is *Brassica rapa*. The greens indeed hold more nutrition profile than the turnip tuber itself with respect to vitamins, minerals and health benefiting anti-oxidants. Turnip greens feature light green, broad leaves with long petiole rising directly from its root top. Turnip leaves are rich in calcium, iron and vitamin C. Leaves based products provide the nutritional and healthy products for maintaining the health status and well-being. The replication five times for all treatments and data obtained from investigation was statically analyzed by using analysis of variance (ANOVA) and critical difference (CD) techniques. Sensory evaluation was carried out by using nine point hedonic scale. In prepared product, Treatment T<sub>3</sub> (15gm leaves, 28.33gm gram flour, 28.33gm flaxseed, 28.34gm pearl millet, 50gm jiggery and 50gm ghee) scored the highest in all aspects in hedonic scale. Nutritional composition of Calcium, Iron and Vitamin C were increased significantly with increased in percentage of prepared product.

**Key words :** Leaves based food product, Turnip greens, interventional approach, micronutrient deficiencies.

## Introduction

Turnip greens are dark-green leafy tops of turnip plant the botanical name of turnip greens is *Brassica rapa*. The greens indeed hold more nutrition profile than the turnip tuber itself with respect to vitamins, minerals, and health benefiting anti-oxidants. Turnips are *brassicaceae* family members and have common growth characteristics with other *brassica* members such as cabbage, kale, brussels sprouts, etc.

World Health Organization (WHO) has defined 'adolescence' as the period between 10 to 19 years. Adolescent girls, constituting nearly one tenth of Indian population, form a crucial segment of the society. Their current nutritional status will decide the well-being of the present as well as the future generation.

Micronutrient malnutrition especially of iron, calcium, and vitamin C is recognized as an important public health problem affecting more than 2 billion people worldwide (WHO, 2000). Left untreated, even sub-clinical

micronutrient malnutrition has significant negative consequences on health and economic development. As many as a third of the world's population do not meet their physical and intellectual potential because of clinical and sub-clinical vitamin and mineral deficiencies. Concern for micronutrient deficiency is particularly high among children as there is an increased nutritional demand among them due to growth spurts and high physical activity. The full genetic potential of the child for physical growth and mental development may be compromised due to sub-clinical deficiencies of micronutrients, making them more vulnerable to develop frequent and more severe common day-to-day infections thus triggering a vicious cycle of under nutrition and recurrent infections. Almost two-thirds of the deaths of children around the world are directly or indirectly associated with nutritional deficiencies.

The plant requires well drained fertile-rich soil. Growing technique of turnip's tender greens differs slightly. Turnips should be planted closely at 4 to 6 inches apart to stunt their bulb (tuber) formation and instead

direct their nutrition into top greens. Its young tender leaves should be harvested early when the plant reaches about 4–6 inches tall. Turnip greens feature light green, broad leaves with long petiole rising directly from its root top. They have taste similar to mustard greens but with less intense spicy flavor. Young tender greens indeed feature sweet flavor with subtle taste of peppery note.

100 g of fresh leaves contain 60 mg or 100% of daily-recommended levels of vitamin C. Vitamin C is a moderately powerful water-soluble antioxidant which helps the body develop resistance against infectious agents and scavenge harmful oxygen-free radicals. This leafy vegetable is notably good in many B-complex groups of vitamins such as riboflavin, folate (48% of RDA/100g), niacin, vitamin B-6 (pyridoxine), thiamin, pantothenic acid, etc., that are essential to the body as part of co-enzymes during the metabolism in the body. Its leaves are also rich source of minerals like magnesium, copper, calcium, sodium, potassium, iron, manganese and phosphorus. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure by countering effects of sodium. Manganese is used by the body as a co-factor for the antioxidant enzyme, *superoxide dismutase*. Iron is required for cellular oxidation and red blood cell formation. Turnip greens are one of the finest sources of essential vitamins, minerals and anti-oxidants that can offer protection from vitamin A deficiency, osteoporosis, iron-deficiency anemia, and believed to protect from cardiovascular diseases and possibly from colon cancers.

### Materials and Methods

The present investigation was Carried out in the Nutritional Research Laboratory, Department of Foods and Nutrition, Ethelind School of Home Science, Sam Higginbottom Institute of Agriculture, Technology & Sciences (Deemed to-be University), (formerly Allahabad Agricultural Institute), Allahabad (U.P.), India.

The raw materials for the recipe development were purchased from the local markets of Allahabad and the surrounding of Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P.), India.

**Proximate analysis :** Chemical estimation of moisture, ash, protein, fat and carbohydrate content was done by using standard procedures (AOAC, 2005).

**Calcium, iron and vitamin C :** Calcium and Vitamin C were estimated by AOAC (2005) using standard procedures, Iron will be determined by using standardized procedure of AOAC (1984).

**Development of food products :** Ladoo were prepared with the incorporation of Turip leaves. The basic

recipe (control  $T_0$ ) had four variations,  $T_1$ ,  $T_2$ ,  $T_3$ ,  $T_4$ , where the amount of one or more ingredients were varied.

### Ladoo from Turnip leaves

- **Control ( $T_0$ ) :** Ladoo prepared from gram flour, pearl millet and flaxseed.
- **Treatment ( $T_1$ ) :** Ladoo prepared from mixture of gram flour, pearl millet and flaxseed and turnip leaves in a ratio of 95:5.
- **Treatment ( $T_2$ ) :** Ladoo prepared from mixture of gram flour, pearl millet and flaxseed and turnip leaves in a ratio of 90:10.
- **Treatment ( $T_3$ ) :** Ladoo prepared from mixture of gram flour, pearl millet and flaxseed and turnip leaves in a ratio of 85:15.
- **Treatment ( $T_4$ ) :** Ladoo prepared from mixture of gram flour, pearl millet and flaxseed and turnip leaves in a ratio of 80:20.

**Replications :** Control and each of the treatments for each product were replicated four times.

**Sensory evaluation :** Sensory evaluation of the food products for their acceptability will be done by a panel of selected judges. The 9 point Hedonic Scale will be used for sensory evaluation, on the basis of evaluation of attributes like colour and appearance, texture, taste and flavour and overall acceptability (Srilakshmi, 2007).

**Determination of nutritive value :** The nutritional values obtained by the chemical analysis of the selected medicinal plants will be computed as well as food composition tables by Gopalan *et al.* (2011) will be used to determine the nutritive value of the products prepared.

### Results and Discussion

The data recorded on different aspects as per the methodology have been tabulated and analyzed statistically. The results obtained from the analysis are presented and discussed in this chapter under the following sub headings.

#### A. Nutritional composition of turnip greens

#### B. Organoleptic characteristics of the products

- The effect of the treatment in 'Ladoo' prepared from Turnip leaves.

#### C. Average nutrient content of the products prepared

Table 1 shows that nutrient concentration per 100g of the product increases in Turnip leaves. The turnip leaves per 100g contained 81.9 percent moisture, 4.0g protein, 1.5g fat, 710mg calcium, 9.4g carbohydrate, 180mg vitamin C, 28.4mg iron and 67 kcal energy.

Table 2 and fig. 1 shows the mean scores of Ladoo

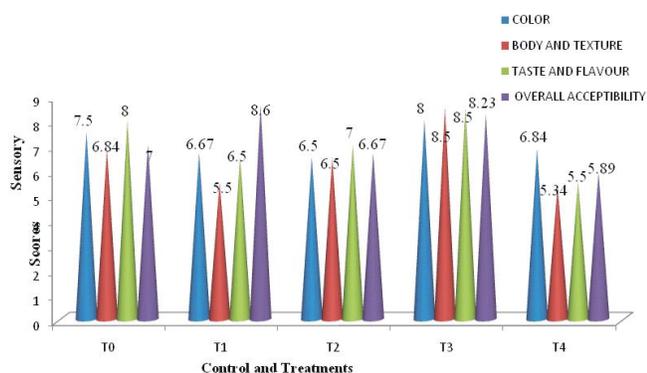


Fig. 1 : Average sensory score for different attributes of *Ladoo* prepared from Turnip leaves.

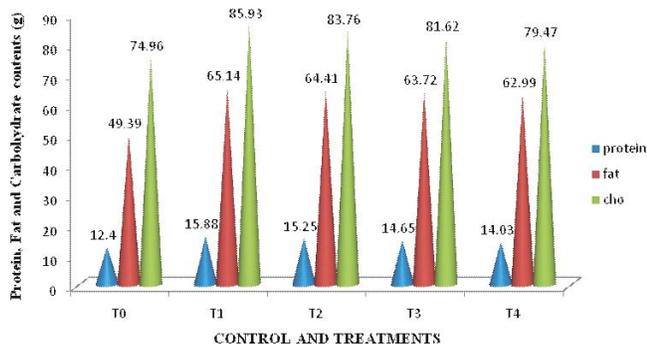


Fig. 2 : Average protein, fat and carbohydrate contents (g) of *Ladoo* prepared from Turnip leaves per 100g.

Table 1 : Chemical composition of Turnip leaves per 100 gm.

Nutrients	Chemical value
Moisture %	81.9
Protein/100g	4.0
Fat g/100g	1.5
Calcium mg/100g	710
Total carbohydrate g/100g	9.4
Vitamin C mg/100g	180
Iron mg/100g	28.4
Energy/ kcal/100g	67

in relation to colour which indicates that T<sub>3</sub> (besan, alsii, bajra + turnip leaves 85:15) had the highest score followed by control T<sub>0</sub> (besan, alsii, bajra without knol-khol leaves), T<sub>1</sub> (besan, alsii, bajra + turnip leaves 95:5), T<sub>2</sub> (besan, alsii, bajra + turnip leaves 90:10) and T<sub>4</sub> (besan, alsii, bajra + turnip leaves 80:20), respectively. Scoring shows that the treatment T<sub>3</sub> (besan, alsii, bajra + turnip leaves 85:15) was liked very much while control and T<sub>1</sub> (besan, alsii, bajra + turnip leaves 95:5), T<sub>2</sub> (besan, alsii, bajra + turnip leaves 90:10) and T<sub>4</sub> (besan, alsii, bajra + turnip leaves 80:20) were moderately liked by the panel of judges.

The texture of *Ladoo* clearly indicates that the treatment T<sub>3</sub> had the highest score for the texture of *Ladoo* (control T<sub>0</sub>), T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub>, respectively.

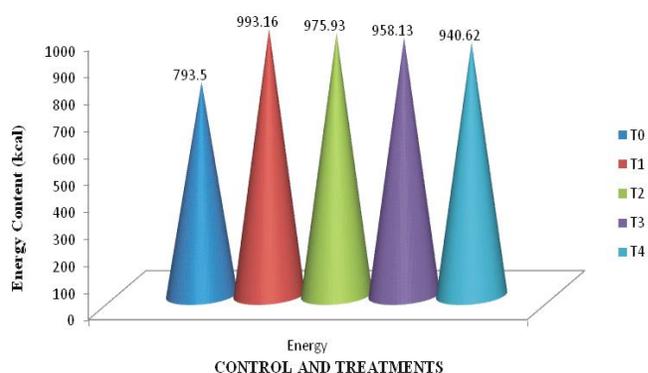


Fig. 3 : Average energy content (kcal) of *Ladoo* prepared from Turnip leaves per 100g.

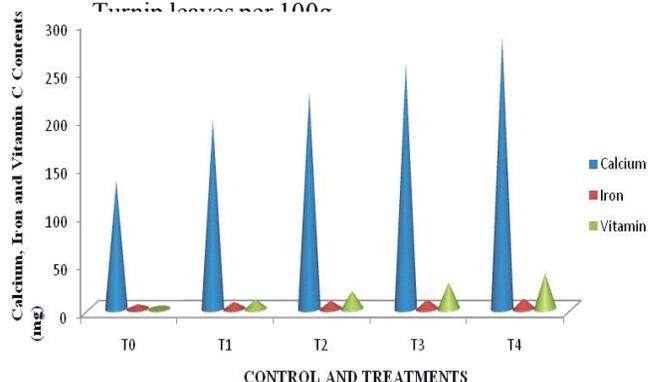


Fig. 4 : Average calcium, iron and vitamin C contents (mg) of *Ladoo* prepared from Turnip leaves per 100g.

The mean score of *Ladoo* in relation to taste and flavor was obtained by control T<sub>0</sub> and T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>3</sub> respectively indicating that T<sub>3</sub> gave the best taste and flavor to *Ladoo*.

The mean scores of *Ladoo* in relation to overall acceptability indicate that the treatment T<sub>3</sub> scored maximum followed by treatment control T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>4</sub>, respectively. It is seen that addition of 15% turnip leaves in the treatment T<sub>3</sub> improved overall acceptability of *Ladoo*.

Table 3 and figs. 2, 3, 4 shows that protein content was highest in T<sub>1</sub> (15.88g) and least in T<sub>0</sub> (12.4g), fat content was highest in T<sub>1</sub> (65.14g) and least in T<sub>0</sub> (49.39g), carbohydrate content was highest in T<sub>1</sub> (85.93g) and least in T<sub>0</sub> (74.96g), energy content was highest in T<sub>1</sub> (993.16 kcal) and least in T<sub>0</sub> (793.5kcal), calcium content was highest in T<sub>4</sub> (282.41mg) and least in T<sub>0</sub> (133.5mg), iron content was highest in T<sub>4</sub> (10.77mg) and least T<sub>0</sub> (4.82mg) and vitamin C content was highest in T<sub>4</sub> (36.79 mg) and least in T<sub>0</sub> (0.75 mg).

### Conclusion

From the result summarized, it is concluded that the prepared product were well accepted with regards to, sensory characteristics. In prepared product, treatment T<sub>3</sub> (15gm leaves, 28.33gm gram flour, 28.33gm flaxseed,

**Table 2 :** The average sensory scores of different parameter in control and treated sample of “*Ladoo*” prepared from turnip leaves.

Organoleptic quality	Treatments							
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>	F5 %	Result	CD=SD=+
Colour and Appearance	7.5	6.67	6.5	8	6.84	3.9189	S	0.7471
Body and Texture	6.84	5.5	6.5	8.5	5.34	16.1666	S	0.5838
Taste Flavour	8	6.5	7	8.5	5.5	268.304	S	0.8438
Overall Acceptability	7	6	6.67	8.23	5.89	18.1573	S	0.4030

**Table 3 :** Average amount of nutrients in control and treated sample of “*Ladoo*” prepared from Turnip leaves per 100g.

Nutrients	Control T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
Protein(g)	12.4	15.88	15.25	14.65	14.03
Fat(g)	49.39	65.14	64.41	63.72	62.99
Carbohydrate(g)	74.96	85.93	83.76	81.62	79.47
Energy(kcal)	793.5	993.16	975.93	958.13	940.65
Calcium(mg)	133.5	196.62	225.2	253.81	282.41
Iron(mg)	4.82	7.27	8.42	9.6	10.77
Vitamin C(mg)	0.75	9.96	18.9	27.85	36.79

28.34gm pearl millet, 50gm jiggery and 50gm ghee) scored the highest in all aspects in hedonic scale. It is therefore concluded that the overall acceptability of *Ladoo* from Turnip leaves differ significantly, which may be ascribed to different ratios of Turnip leaves in *Ladoo*. Nutritional composition of calcium, iron and vitamin C were increased significantly with increased in percentage of prepared product.

### Recommendation

Incorporation of different proportions of Turnip leaves for value addition in recipes will improve intake of calcium, iron and vitamin C. It can also add variety to the diet and its utilization may be increased as it is an underutilized edible ingredient. These products can also be helpful for providing variety in the daily dietaries in addition to their nutritional benefits. Due to incorporation of the leaves and flour, the medicinal value of the product increases. Its high nutrient content, they help in micronutrient deficiency.

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