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 an evaluation of many traditional herbal system 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. Knol-khol also known as Kohlrabi (German turnip or turnip cabbage); Brassica oleracea is an annual vegetable, and is a low, stout cultivar of cabbage. Kohlrabi can be eaten raw as well as cooked. Edible preparations are made with leaves. Knol-khol 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 time 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_3 (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.*

Keywords: leaves based food product, Knol-khol

1. Introduction

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 an evaluation of many traditional herbal system of medicine.

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 peesent 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 **(Best *et al.*, 2011).**

Knol-khol (*Brassica oleracea*) is known by many names in India. It is popular in Kashmir, West Bengal, Maharashtra, Assam, Uttar Pradesh, Punjab and some parts of south India, but it is not cultivated commercially.

Kohlrabi is found to be rich in dietary fiber, carotenoids, vitamin C. Besides the vitamins, this vegetable is also rich in calcium, iron and phosphorus. The many health benefits of kohlrabi are very similar to those vegetables from the cruciferous family: they helps to prevent acidosis, asthma, maintain cholesterol level, kohlrabi juice also helps in easing skin problems, regularly drink a glass of carrot and kohlrabi juice in the morning with plenty of water throughout the day for good results, aids in weight loss, helps to prevent anemia and osteoporosis, helps to improve digestive health, reduces strain on cardiovascular system, reduces risk of breast and prostate cancer, improves body metabolism, lowers risk of stroke or heart attack, helps to improve nerve and muscle function, boosts immune system and cardiovascular system.

2. 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.

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.

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 knol-khol 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 Knol-khol 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, flaxseed and knol-khol leaves in a ratio of 95:5.
- **Treatment (T_2):** *ladoo* prepared from mixture of gram flour, pearl millet, flaxseed and knol-khol leaves in a ratio of 90:10.
- **Treatment (T_3):** *ladoo* prepared from mixture of gram flour, pearl millet, flaxseed and knol-khol leaves in a ratio of 85:15.
- **Treatment (T_4):** *ladoo* prepared from mixture of gram flour, pearl millet, flaxseed and knol-khol 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.

3. 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 Knol-Khol Greens
b) Organoleptic Characteristics of the Products. The effect of the treatment in *'Ladoo'* prepared from Knol-Khol leaves.
c) Average nutrient content of the products prepared

Table A.1: Chemical composition of Knol-khol leaves per 100 gm.

Nutrients	Chemical Value
Moisture %	86.7
Protein/100g	3.5
Fat g/100g	0.4
Calcium mg/100g	740
Total carbohydrate g/100g	6.4
Vitamin C mg/100g	157
Iron mg/100g	13.3
Energy/ kcal/100g	43

Table.A.1 shows that nutrient concentration per 100g of the product increases in Knol-khol leaves. The knol-khol leaves per 100g contained 86.7 percent moisture, 3.5g protein, 0.4g fat, 740mg calcium, 6.4g carbohydrate, 157mg vitamin C, 13.3mg iron and 43kcal energy.

Table B.1: The average sensory scores of different parameter in control and treated sample of "*Ladoo*" prepared from Knol-Khol leaves

Organoleptic quality	Treatments							
	T_0	T_1	T_2	T_3	T_4	F5 %	Result	CD=SD=+,
Colour and Appearance	7.84	6.5	7.5	8.84	5.5	196	S	0.1685
Body and Texture	7	6.67	6.84	8.84	5.84	11.5196	S	0.59943
Taste Flavour	8	7	7.67	9	6	188.375	S	0.1506
Overall Acceptability	7.67	7.03	7.5	8.75	5.34	4.91	S	0.2820

Table.B.1 and **fig B.1** shows the mean scores of *Ladoo* in relation to colour which indicates that T_3 (gram flour, flaxseed, pearl millet + knol-khol leaves 85:15) had the highest score followed by control T_0 (gram flour, flaxseed, pearl millet without knol-khol leaves), T_1 (gram flour, flaxseed, pearl millet + knol-khol leaves 95:5), T_2 (gram flour, flaxseed, pearl millet + knol-khol leaves 90:10) and T_4(gram flour, flaxseed, pearl millet + knol-khol leaves 80:20) respectively. Scoring shows that the treatment T_3 (gram flour, flaxseed, pearl millet + knol-khol leaves 85:15) was liked very much while control and T_1 (gram flour, flaxseed, pearl millet + knol-khol leaves 95:5), T_2 (gram flour, flaxseed, pearl millet + knol-khol leaves 90:10) and T_4 (gram flour, flaxseed, pearl millet + knol-khol leaves 80:20) were moderately liked by the panel of judges.

The texture of *Ladoo* clearly indicates that the treatment T_3 had the highest score for the texture of *Ladoo* (control T_0), T_1, T_2 and T_4 respectively.

The mean score of *Ladoo* in relation to taste and flavor was obtained by control T_0 and T_1, T_2, T_3, T_3 respectively indicating that T_3 gave the best taste and flavor to, *Ladoo*.

The mean scores of *Ladoo* in relation to overall acceptability indicate that the treatment T_3 scored maximum followed by treatment control T_0, T_1, T_2 and T_4 respectively. It is seen that addition of 15% knol-khol leaves in the treatment T_3 improved overall acceptability of *Ladoo*.
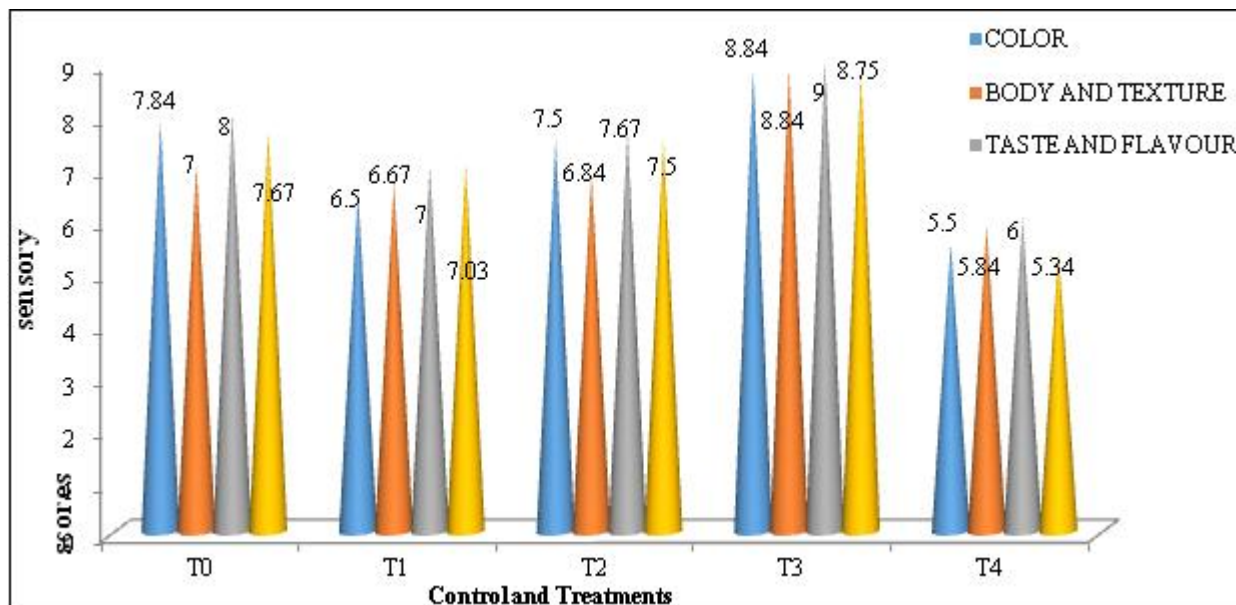
Figure B.1: Average sensory score for different attributes of *ladoo* prepared from knol-khol leaves

Table C.1: Average amount of nutrients in control and treated sample of "*Ladoo"* prepared from Knol-khol leaves per 100g.

Nutrients	Control T_0	T_1	T_2	T_3	T_4
Protein(g)	12.4	15.86	15.2	14.58	13.293
Fat(g)	49.39	65.08	64.3	63.55	62.78
Carbohydrate(g)	74.96	85.78	83.46	81.17	78.87
Energy(kcal)	793.5	991.96	973.23	954.53	935.85
Calcium(mg)	133.5	198.12	228.2	258.31	288.41
Iron(mg)	4.82	6.52	6.91	7.34	7.75
Vitamin C(mg)	0.75	8.81	16.6	24.4	32.19

Table.C.1 and **fig C.1, C.2, C.3** shows that protein content was highest in T_1 (15.86g) and least in T_0 (12.4g), fat content was highest in T_1 (65.08g) and least in T_0 (49.39g) , carbohydrate content was highest in T_1 (85.78g) and least in T_0 (74.96g), energy content was highest in T_1 (991.96kcal) and least in T_0 (793.5kcal), calcium content was highest in T_4 (288.41mg) and least in T_0 (133.5mg) , iron content was highest in T_4 (7.75mg) and least T_0 (4.82mg) and vitamin C content was highest in T_4 (32.19 mg) and least in T_0 (0.75 mg).
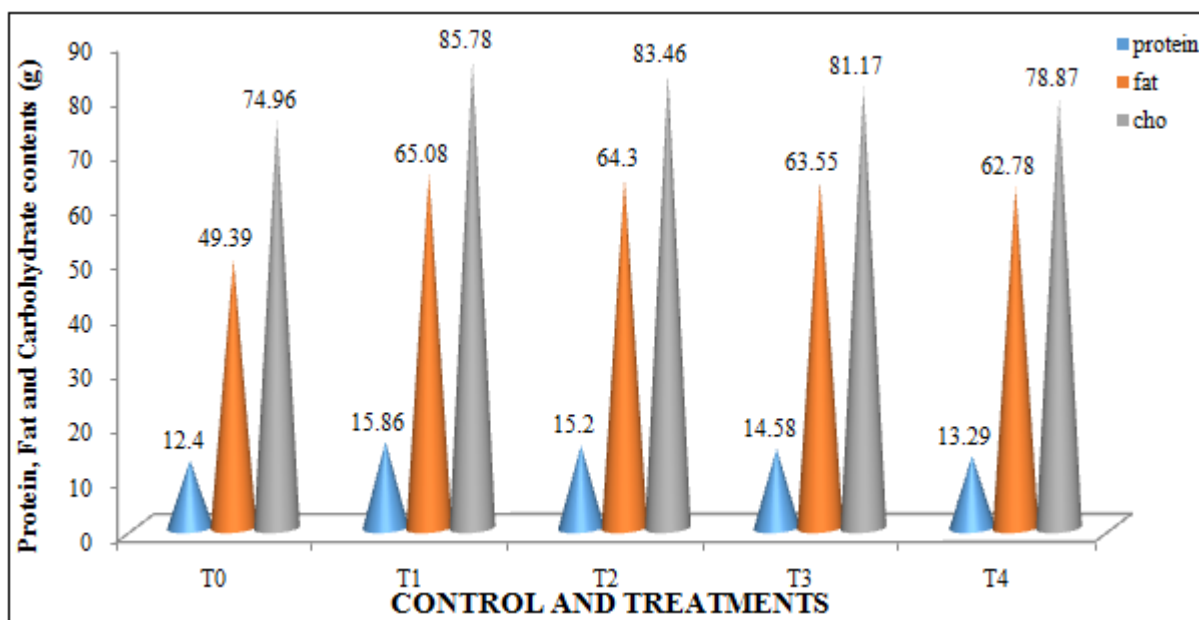

Figure C.1: Average protein, fat and carbohydrate contents (g) of *Ladoo* prepared from Knol-Khol leaves per 100g.
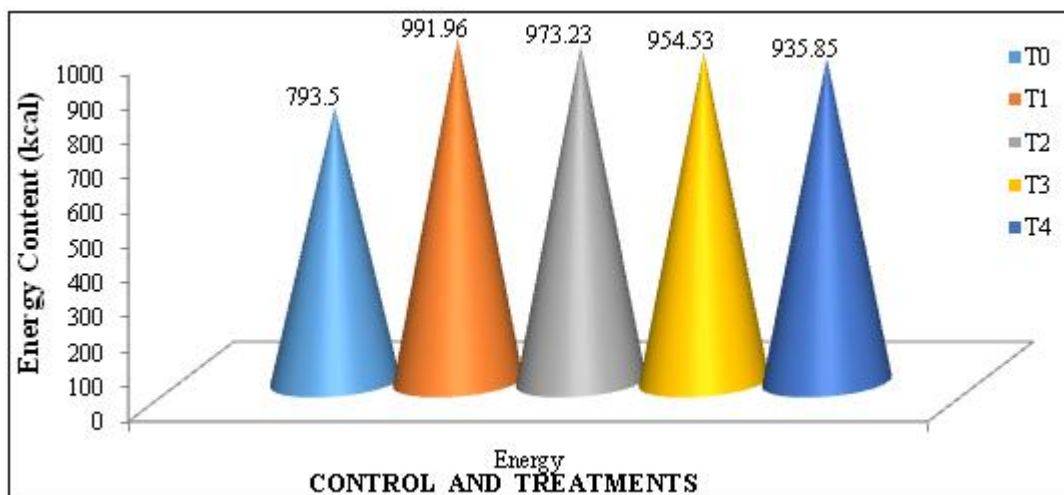
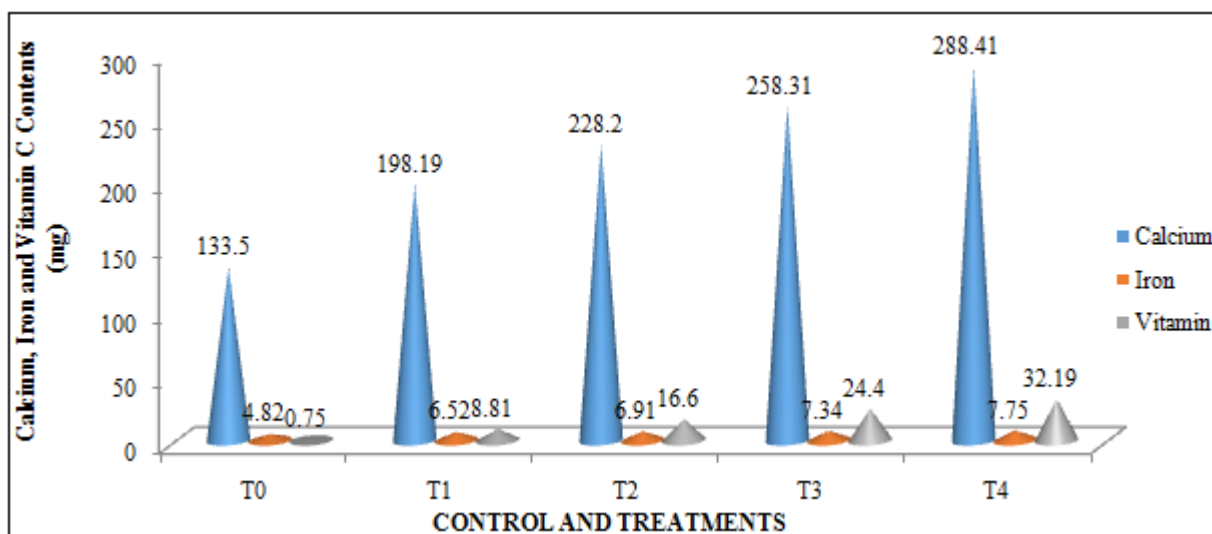**Figure C 2:** Average energy content (kcal) of *Ladoo* prepared from Knol-Khol leaves per 100g.

Figure C 3: Average calcium, iron and vitamin C contents (mg) of *ladoo* prepared from Knol-Khol leaves per100g.

4. 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_3 (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. It is therefore concluded that the overall acceptability of *Ladoo* from knol-khol leaves differ significantly, which may be ascribed to different ratios of knol-khol leaves in *Ladoo*. Nutritional composition of Calcium, Iron and Vitamin C were increased significantly with increased in percentage of prepared product.

5. Recommendation

Incorporation of different proportions of Knol-khol leaves powder 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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