

## A Study on Food Fortification to Alleviate Anaemia

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### Abstract

*Context:* The juice of raw beetroot contains host of health benefits and is classed as a “super food” in today’s nutritional jargon for anaemia. *Aims:* To determine the effectiveness of enriched beetroot juice on serum iron level and clinical symptoms between study and control group of adolescent girls. *Settings and Design:* The sample size selected for this study consists of 80 adolescent girls of age 13-18 years (Haemoglobin <9gm/dl) assigned to study and control group. *Methods and Material:* 150ml of enriched beetroot juice was served to each of the study subject every alternate days for three months (45 days). Control group was served with a placebo. Nutrition education was given to all the participants(n=80). serum iron (dipyridyl method) was assessed and nutritional assessment for iron deficiency anaemia was performed. *Statistical analysis used:* Descriptive statistics like percentage and paired ‘t’ test was performed. *Results:* 50 per cent of subjects suffering from fatigue and feeling of weakness (13-15yrs) reduced to 10 per cent after fortified beet-root extract intervention. The mean serum iron (16-18yrs) level improved significantly ( $t=13.86, p<.0001$ ) in the study group. *Conclusions:* Enriched beet-root juice supplementation improved the nutritional status and serum iron levels of adolescents.

**Keywords:** Enriched Beet-Root Juice; Anaemia; Supplementation; Serum Iron; Placebo.

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### Introduction

Adolescents are particularly vulnerable to nutrient deficiencies especially iron leading to anaemia. Without added vitamins and minerals, many children and teens don’t meet daily nutrient requirements [1]. Fortified and enriched foods are important sources of nutrients for the growing period, especially for iron, zinc, and B vitamins they can fill in the gaps and increase a particular vitamin and mineral consumption that would otherwise be less than the recommended value [2].

Though iron and folic acid supplementation remains the corner stone in treatment of anaemia nutrition education and food supplementation are long term measures in preventing the recurrence.

A food-based strategy has the goal of improving nutrition through increasing the availability

and consumption of a nutritionally adequate micronutrient rich diet made up of a variety of available foods [3].

Good nutrition is not just about having enough food, but about having the right food, at the right times. The food we eat must contain enough nutrients otherwise we can become malnourished.

Food fortification is one important step in making sure populations gain a balanced diet. It helps to fill micronutrient gaps where populations struggle to access nutritious foods, which is especially important as populations grow, live in more urban areas, and consume more processed foods rather than freshly grown food [4].

A number of potential dietary sources need to be urgently promoted including many leafy vegetables like beet-root The process of selecting the best food vehicle and iron source may appear simple but is actually a complex process that requires evaluation at every step [5]. Beet-root juice is possibly the best natural remedy for anaemia. It helps to increase the blood count and improve blood circulation and oxygen carrying capacity of erythrocytes [6].

The study was conducted to assess the prevalence of anaemia among adolescent (12-18yrs) girls and estimate the impact of supplementation of iron rich beet-root juice on serum iron values.

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## Subjects and Methods

Government- aided girls school of Chennai city was selected and designed to include eligible adolescent students in the age group of 12 – 18 years. Ethical approval was obtained from school authorities, students and parents. They were briefed about the supplementation study with fortified beetroot juice.

Baseline haemoglobin (cyanmethaemoglobin) was assessed for 118 adolescent students (12-18 yrs). 98 adolescents were found to be anaemic (Haemoglobin <9gm/dl). 80 study participants were randomly assigned to two groups. The study group and control group. The participants were appraised of anaemia and the importance of fortified beetroot extract in combating anaemia through nutrition lecture.

The concept of the enriched product took shape after a series of trials using ingredients in various proportion. Enriched beet-root juice was processed by grinding 1 kilogram of beet root with 10gms ginger, 500 grams sugar the juice extracted with 2 litres of water and 30ml of fresh-lime juice. 150ml of beetroot juice was given to each of the intervention subject on every alternate days for three months (45days).

Serum iron (dipyridyl method) was estimated at pre and post test. The study participants were screened for clinical symptoms pertaining to nutritional iron deficiency anaemia based on standard WHO (1963) procedure.

Students paired 't' test was performed to find the difference between pre and post test.

## Results

Distribution of subjects according to clinical signs and symptoms of anaemia ( Table 1) showed that 55 per cent of the subjects depicted pale skin followed by 90 per cent with pigmentation of nails. Drinking beet-root juice helps in healthy glowing skin [7]. Impact of enriched beet-root juice supplementation reduced the symptoms. Whereas 50 per cent of subjects suffering from fatigue and feeling of weakness reduced to 10 per cent after fortified beet-root juice intervention, while Poor appetite was reported by 30 per cent of adolescent subjects. Frequent headache was reported by 50 per cent of subjects. After fortified beet-root juice intervention the symptoms reduced to 10 per cent. Beetroot juice is particularly beneficial

as an anemia remedy for children and teenagers. consuming beet root juice or beet as cooked vegetable in salad is highly beneficial in treating anemia [8].

Food-based intervention programs like dietary enhancement and diversification, food fortification including bio fortification play a critical role in alleviating micronutrient deficiencies [9]. In the Post-adolescent (16-18yrs) age group as evident from Table 2 about 75 (n=15) per cent of subjects depicted skin paleness in the pre intervention group, pigmentation of nails were observed in 40 per cent. It was observed that 75 per cent (n=15) of subjects were reported to suffer from fatigue and feeling of weakness The impact of enriched beet-root juice supplementation reduced the symptoms to 10 per cent.

The detoxifying ability of beet-root helps in curing skin problem and helps to hydrate the skin. The impact of nutrition education alone in the control group not much impact was observed at the post test stage. Adolescence is a period of rapid growth with stress and strain. Frequent headache reported by 80 per cent of subjects in the pre intervention group reduced to 5 per cent.

Serum iron test measures the amount of iron in the blood A significant increase ( $t=16.97$ ,  $p<.0001$ ) in the mean serum iron level (Table 3) was observed (13-15years). The baseline value  $55.30\pm 2.37$  gradually increased to  $109.40\pm 9.49$  after three months of intervention. In the control group the increase was not significant ( $t=0.26$ ,  $p=0.79$ ). Fortified beet-root extract intervention for three months had high significance ( $t=15.57$ ,  $p<.0001$ ) in the mean serum iron level compared to control.

The antioxidant property of beetroot helps to scavenge free radicals to prevent aging, cancer and reduce blood pressure to help the muscles in uptake of oxygen [10]. There was significant ( $t=13.86$ ,  $p<.0001$ ) increase in the mean serum iron level (16-18yrs) of the post- intervention group. The baseline ( $54.85\pm 3.0$ ) serum iron gradually increased ( $104.75\pm 6.71$ ) after three months of Supplementation. Whereas the mean difference ( $1.7\pm 1.27$ ) in the control group was not significant ( $t=2.78$ ,  $p=0.011$ ). Beeturia is a term applied to the deep red or pink coloration of urine which may occur after the ingestion of beetroot [11]. The impact of fortified beet-root extract intervention in the mean serum iron level for three months was statistically significant ( $t=14$ ,  $p<.0001$ ) compared to control.

**Table 1:** Nutritional assessment of adolescent girls

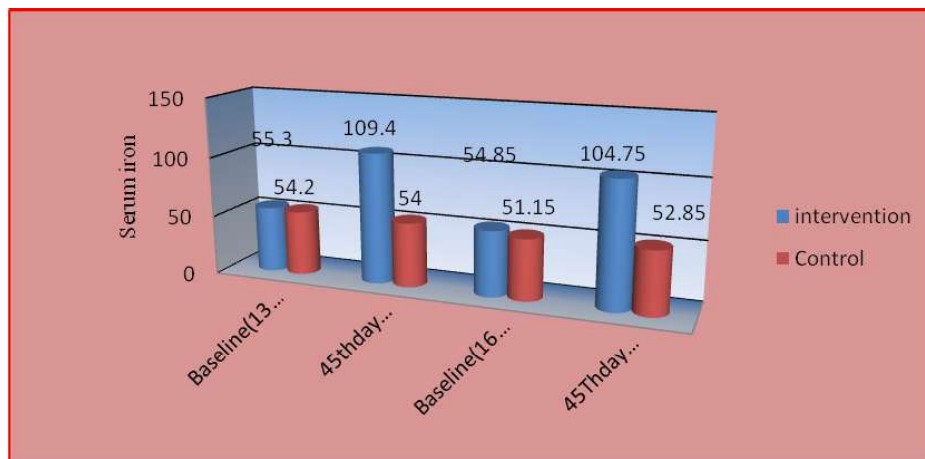
S.No	Factors	13-15years							
		Study (n=20)				Control (n=20)			
		Pre-test		Post-test		Pre-test		Post-test	
No	Percent	No	Percent	No	Percent	No	Percent		
1	Pallor of skin	11	55	1	5	10	50	10	50
2	Pigmentation of nails	18	90	-	-	16	80	11	55
3	Fatigue and weakness	10	50	2	10	10	50	8	40
4	Bleeding gums	3	15	-	-	2	10	-	-
5	Tooth decay	5	25	1	5	4	20	2	-10
6	Frequent headache	10	50	2	10	13	65	11	55
7	Poor appetite	6	30	2	10	4	20	4	20

**Table 2:** Nutritional assessment of adolescent girls

S. No	Factors	16-18years							
		Study (n=20)				Control (n=20)			
		Pre-test		Post-test		Pre-test		Post-test	
No	Percent	No	Percent	No	Percent	No	Percent		
1	Pallor of skin	15	75	2	10	13	65	9	45
2	Pigmentation of nails	8	40	-	-	7	35	6	30
3	Fatigue and weakness	15	75	-	-	16	80	13	65
4	Bleeding gums	2	10	-	-	2	10	-	-
5	Tooth decay	4	20	-	-	5	25	3	15
6	Frequent headache	16	80	1	5	13	65	10	50
7	Poor appetite	10	50	2	10	10	50	12	60

**Table 3:** Mean serum iron values of adolescents

Groups	Baseline	Final 3 <sup>rd</sup> month 45 <sup>th</sup> day	Mean difference	T value	Sood 1990
Experimental (13-15yrs) A <sub>1</sub>	55.30±2.37	109.4±9.49	54.1±9.11	16.97	60-160µg/dl
Control (13-15yrs) B <sub>1</sub>	54.2±2.89	54±2.9	0.20 ±1.63	0.26 A <sub>1</sub> vsB <sub>1</sub> 15.57	
Experimental (16-8yrs) A <sub>2</sub>	54.85±3.0	104.75±6.71	49.90±7.52	13.86	60-160µg/dl
Control (16-18yrs) B <sub>2</sub>	51.15±4.35	52.85 ±4.33	1.70±1.27	2.78 A <sub>2</sub> vsB <sub>2</sub> 14	



**Fig. 1:** Mean serum iron values

## Discussion

Serum iron status improved with fortified beet-root juice supplementation for three months (45days) and clinical symptoms related to nutritional iron deficiency anaemia improved significantly. Fatigue and weakness completely reduced. The baseline  $55.3 \pm 2.37$  serum iron value (13-15years) gradually increased to  $109.4 \pm 9.49$  after three months of supplementation. Fortified beet-root juice supplementation for three months had high significance ( $t=15.57$ ,  $p < .0001$ ) in the mean serum iron level compared to control. The baseline ( $54.85 \pm 3.0$ ) serum iron (16-18yrs) gradually increased ( $104.75 \pm 6.71$ ) after three months of intervention.

Fortified beet-root juice supplementation on alternate days along with nutrition education helped to improve the nutritional status and serum iron index. The study revealed that organic forms of nutrients derived from natural sources are much easier to assimilate than synthetic nutrients. Thus the iron content in beetroot juice is easily assimilated and helps to increase the serum iron index.

## Acknowledgement

I thank the college and the consumers for the support rendered for the study.

## Key Messages

The beetroot juice contributes to improve the nutritional status and serum iron levels of adolescents. The cost of the beetroot is low when compared to other iron rich vegetables and it can be stored easily. Hence the present study was conducted on adolescent girls.

## References

1. Srinivasan K, Shekhar C, Arokiasamy P. Reviewing reproductive and child health programmes in India. *Economic and Political Weekly*. 2007;29:31-9.
2. Bhanushali MM, Shirole AR, Joshi YM, Kadam VJ. An intervention on iron deficiency anaemia and change in dietary behavior among adolescent girls. *International journal of pharmacy and pharmaceutical sciences*. 2011;3(1):40-2.
3. Thompson B. Food-based approaches for combating iron deficiency. *Nutritional anemia*. 2007:337.
4. Coles LT, Clifton PM. Effect of beetroot juice on lowering blood pressure in free-living, disease-free adults: a randomized, placebo-controlled trial. *Nutrition journal*. 2012;11(1):1.
5. Tunnessen WW, Smith C, Oski FA. Beeturia: a sign of iron deficiency. *American Journal of Diseases of Children*. 1969;117(4):424-6.
6. Pandey S, Singh V. Food Fortification to Combat Iron Deficiency Anaemia. *International Journal of Advanced Nutritional and Health Science*. 2013;1(1): 39.
7. Bothwell TH, Mac Phail P. Prevention of iron deficiency by food fortification. In *Nestle nutrition workshop series (USA) 1992*.
8. Patil SV, Durgawale PM, Kakade SV, Dighe S. An assessment of interventional strategies for control of anemia among adolescent girls in an urban slum of Karad, Dist. Satara, Maharashtra. *Al Ameen Journal of Medical Sciences* 2014;07(3):195-200.
9. DeMaeyer EM, Dallam P, Gurney JM, Hallberg L, Sood SK, Srikanta SG. *A guide for health administrators and programme managers*. World Health Organization. 1989.
10. Rupal P, Francis L, Jeenath Justin Doss. K.A study to assess the effectiveness of beetroot juice with jaggery on anemia among adolescent girls in the selected urban area at rajkot. *Int. J. Nur. Edu. and Research*. 2017;5(2):140-42.
11. Gayathri Priya N, Malarvizhi M, Jega Jothi A. Beet root juice on haemoglobin among adolescent girls. *IOSR Journal of Nursing and Health Science*. 2013;2(1):9-13.