ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 5, Issue, 09, pp.2474-2477, September, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

EFFECT OF RAGI (*Eleusine coracana*) VERMICELLI SUPPLEMENTATION ON ANEMIC SCHOOL CHILDREN

Kathy, M. [*, 1], Sheila John[1], D. Estherlydia[2]

[1]Department of Home Science, Women's Christian College, Chennai – 600006
[2]Food Chemistry and Food Processing, Department of Chemistry, Loyola College, Chennai-600034

ARTICLE INFO

Article History:
Received 24th July, 2013
Received in revised form
04th July, 2013
Accepted 29th August, 2013
Published online 14th September, 2013

Key words:
Anthropometry,
Biochemical,
Anemia,
Finger millet.

ABSTRACT

Iron deficiency anaemia is the most common nutritional deficiency in children. Dietary intervention using finger millet can aid in preventing anemia among children. The study aimed at supplementing developed recipes from Finger millet (*Eleusine coracana)* or ragi Vermicelli on the anthropometric and hematological parameters of school children age 6 – 12 years. Pre-test Post –test design with test group (n=12) on supplementation and control group (n=12) in study period was designed. The supplementation was given for five days a week for a period of 45 days. Supplementation of Ragi vermicelli showed a significant 3.31 percent increase in the body weight (21.17 ± 3.28 to 21.83 ± 3.24 kg), as well as a 2.65 percent significant increase in the BMI (14.75 ± 1.89 to 15.15 ± 2.01 kg/m^2) at the end of the supplementation period ($p<0.05$). No significant change in hemoglobin was observed on the 46th day. The results showed a non-significant increase in the hematological parameters. Nutrition education programme increased the knowledge and awareness of dietary iron intake among the children ($p<0.001$). Ragi which is rich in iron is an extremely low cost nutritious cereal and is very beneficial for maintaining a good health.

INTRODUCTION

Anemia is a public health problem that affects populations in both rich and poor countries. It is also a major nutritional problem, affecting 20-70 % of the population in various countries (WHO, 2008). Prevalence of anemia in young children continues to remain over 70% in most parts of India and Asia despite a policy being in place and a program that has been initiated for a long time. The irreparable damage that anemia in childhood can cause particularly to the development of a young child on one hand and the knowledge and mechanism available for its control on the other, makes this silent morbidity completely unacceptable in modern times where we strive for millennium development Goal (Kotecha, 2011). In Tamilnadu, the prevalence of anemia was 52. 88 percent as per the World Health Organization (WHO) suggested cutoff value of hemoglobin in children between 6-14 yrs (Sudhagandhi *et al*., 2011).

Iron deficiency that progresses to anemia can have significant long-term effects. Children who have anemia score lower on tests of mental and motor development than those who do not. The severity and duration of anemia correlate with poorer test performance (Lozoff *et al*., 2006). The most common reason for iron-deficiency anemia in children is the inadequate supply of iron in the diet. Children go through periods of rapid growth and the diet should supply enough to facilitate the increased need for more red blood cells. Poor diet quality and low dietary iron bioavailability are the principal factors that contribute to the increased incidence of iron deficiency (Tatala *et al*., 1998). Finger millet (***Eleusine coracana)*** or Ragi as commonly known is regularly used in the South Indian kitchens. It is in fact the staple diet in many villages across south India. People down south draw their strength heavily through consumption of Ragi which is a popular food. It constitutes a little over 25% of the food grains grown in India. Nutritionally it is almost as good as or better than wheat or rice. The major proteins of ragi are prolamins and glutenins and they appear to be adequate in all the essential amino acids. Ragi is rich in minerals especially calcium. It is also rich in fibre. It is also rich in phytate and tannin and hence interferes with mineral availability. It contains B-vitamins but is poor in B2 (Halterman *et al*., 2001). Of all the cereals and millets, finger millet has the highest amount of calcium (344mg%) and potassium (408mg%). It has higher dietary fiber, minerals, and sulfur containing amino acids compared to white rice, the current major staple in India. Despite finger millet's rich nutrient profile, recent studies indicate lower consumption of millets in general by urban Indians. Finger millet is processed by milling, malting, fermentation, popping, and decortication. Noodles, vermicilli, pasta, Indian sweet (halwa) mixes, papads, soups, and bakery products from finger millet are also emerging. In vitro and in vivo (animal) studies indicated the blood glucose lowering, cholesterol lowering, antiulcerative, wound healing properties, etc., of finger millet. However, appropriate intervention or randomized clinical trials are lacking on these health effects (Shobana *et al*., 2013). Incorporating easily available unexploited foods rich in iron like ragi to prevent iron deficiency anemia is the need of the hour. Thus the present study was aimed to reducing the incidence of iron deficiency anemia among children by supplementing ragi vermicelli.

MATERIALS AND METHODS

The present study was carried out to determine the effect of ragi vermicelli on the Anthropometric measurements and hematological parameters of children.

a) Baseline period- the children are dewormed. Supplementation was stated after fifteen days from deworming

Corresponding author: Kathy, M. *Department of Home Science, Women's Christian College, Chennai – 600006*

b) Test group -
1) Day 1- beginning of supplementation period.
2) Day 45- end of supplementation period.
c) Control group - no supplementation was given,
1) Day 1 – beginning of study period
2) Day 45 – end of the study period.
The study was carried out in the following phases

Phase I: Ex post facto design was used to collect information on demographic profile, health status and existing dietary habits of the children.

Phase II: Initial hematological screening was used to identify twenty four anemic children for the study out of which 12 were randomly assigned to the experimental group and 12 to the control group. There was an equal distribution of boys and girls.

Phase III: Anthropometric measurements and indices of the children were ascertained. These include body weight, height measurements, and body mass index.

Phase IV: Five different recipes using Ragi Vermicelli was formulated and the sensory quality was ascertained with a trained sensory panel.

Phase V: Anthropometric parameters and hematological parameters like hemoglobin, Mean corpuscular volume (MCV),Mean corpuscular hemoglobin (MCH),Mean corpuscular hemoglobin concentration (MCHC), iron and Total iron binding protein (TIBC) was assessed before and after 45 days of supplementation of ragi vermicelli. Biochemical parameters were analyzed in Lancet Laboratory, Chennai.

Phase VI: A nutrition education program was conducted to impart knowledge and to create awareness on the importance of nutrition.

Criteria for Sample Selection

The criteria for the selection of the children were

- Willingness to co-operate in the study
- Children in the age group of 6-12years.
- Children whose hemoglobin level was less than 11.5mg/dl (WHO, 2005)
- Children who does not have any chronic illness.

Supplement: A dosage of 75g of ragi vermicelli was given as evening snack for five days a week for a period of 45 days as ragi vermicelli payasam, ragi vermicelli kitchadi, ragi vermicelli greens adai, ragi vermicelli nutty snack, ragi vermicelli puttu.

Table 1: Nutritive value of Ragi Vermicelli per 100g

Energy (k cal)	
Carbohydrate (gm)	71.74g
Protein (gm)	11g
Fats (gm)	2.1g
Iron (mg)	5.9mg
Calcium (mg)	310.08mg

Nutrition Education Program

Audio visual aids were used for the nutrition education program. The content of the lecture involved importance of food, balanced diet, five food groups, importance of nutrients and on iron deficiency anaemia its causes, symptoms, prevention through diet and food sources of iron. The methods used for demonstrations, power point presentations, puppets, songs, posters and advertisements. The nutrition knowledge and awareness of the Children was assessed before and after the nutrition education program using a checklist.

Statistical analysis

SPSS version was used to conduct the statistical analyses.

- Frequency tables were generated for the descriptive data.
- Test of significance was used to assess the impact of supplementation.
- The type I error rate was a P value of <0.05 was considered statistically significant for all statistical tests conducted.

Human Protection

The study protocol was reviewed by the delegated independent ethics committee of Women's Christian College, Chennai and approval was obtained for conducting the study. The children were informed about the aims, methods and procedures of the study prior to data collection. The research study was scrutinized by qualified and experienced team of experts

RESULTS AND DISCUSSION

Demographic Profile

Demographic data of the children indicate that 41.7 percent of the children belong to the age group 6-8 years and 33.3 percent of children belong to the age between 10-12 years. Boys and girls were equally distributed in the experimentation and the control group. All children belong to the nuclear type of family.

Health Status of anemic children

Data indicated that 33.3 percent of the children had skin infection and 16.7 percent of the children had GI tract infection. About 58.3 percent of the children had normal appetite and all of them had regular bowel movement. Majority of the children (75%) indicated they had no symptoms related to anaemia, 12.5 percent were excessively tired and weak and 8.3 percent had the problem of sleeplessness.

Dietary Habits

All the children were non-vegetarians and they consumed three meals per day. About 41.7 percent of children skip breakfast. Among those who skip breakfast 29.2 percent skipped breakfast rarely and 12.5 percent skipped having breakfast daily. Reasons for skipping breakfast include (29.2%) lack of hunger and (29.2%) lack of time. It was found that the reason for skipping breakfast was due to lack of hunger and lack of time. Children compensated the need for breakfast was over eating during lunch and consuming soft drinks.

Anthropometric Assessment

Anthropometric measurements and indices of the Children were ascertained before and after the supplementation period. They included height, body weight measurements, and body mass index. The mean anthropometric measurements of the test and control group before and after the supplementation period are presented in table 2. Supplementation of Ragi vermicelli showed a significant 3.31 percent increase in the body weight (21.17 ± 3.28 to 21.83 ± 3.24 kg), as well as a 2.65 percent significant increase in the BMI (14.75 ± 1.89 to 15.15 ± 2.01 kg/m^2) at the end of the supplementation period ($p<0.05$). The control group showed 0.61 percent decrease in body weight and 0.59 percent decrease in BMI, but these changes were not significant. There was a managerial increase in the height, may be due to growth at this age but this increase was also not significant.

Biochemical Parameters

Hematological parameters such as Hemoglobin, Mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC), serum iron, and Total iron binding protein (TIBC) were assessed in test and control group

Table 2: Test of significance of the Anthropometric measurements before and after supplementation

Group	Parameter	Mean ± SD		Percent Change	't' test	Level of significance
		Day 1	Day 46			
Test group (n=12)	Height (cm)	119.96 ±9.88	120.17 ± 9.76	0.18 ↑	1.83	0.096 NS
	Body weight (kg)	21.17 ± 3.28	21.83 ± 3.24	3.31↑	3.55	0.005**
	BMI (kg/m^2)	14.75 ± 1.89	15.15 ± 2.01	2.65↑	2.59	0.025*
Control group (n=12)	Height (cm)	130.75 ±12.5	130.88 ± 12.4	0.10↑	1.39	0.191 NS
	Body weight (kg)	26.75 ± 7.09	26.58 ± 6.32	0.61↓	0.46	0.658 NS
	BMI (kg/m^2)	15.68 ± 2.13	15.36 ± 2.02	0.59↓	0.73	0.486 NS

**Significant at p<0.001,* Significant at p<0.05, NS- Not Significant

Table 3: **Test of significance of the Hematological parameters before and after supplementation**

Group	Parameter	Mean ± SD		Percent Change	't' test	Level of Significance
		Day 1	Day 46			
Test group (n=12)	Hemoglobin(g/dl)	11.150 ± 0.3	11.275 ± 0.3	1.17↑	1.15	**0.278** NS
	MCV (f L)	75.50 ± 4.4	79.87 ± 5.2	5.89↑	3.25	**0.008****
	MCH (pg)	23.90 ± 1.2	25.44 ± 1.6	6.53↑	4.06	**0.002****
	MCHC (%)	31.54 ± 0.3	31.94±0.9	1.30↑	1.17	**0.268** NS
	IRON(µg/dl)	86.25 ± 25.8	86.35 ± 21.6	1.15↑	0.06	**0.956** NS
	TIBC(µgm/dl)	330.17 ± 48.0	331.96 ± 47.6	2.00↑	0.84	**0.423** NS
Control group (n=12)	Hemoglobin (g/dl)	10.91 ± 0.3	11.05 ± 0.4	0.28↑	1.04	**0.325** NS
	MCV (fL)	74.63 ± 3.16	78.28 ± 4.15	4.98↑	3.03	**0.012***
	MCH (pg)	23.33 ± .85	24.93 ± 1.6	6.90↑	3.59	**0.004****
	MCHC (%)	31.80 ± .87	31.72 ± 0.5	0.20↓	0.29	**0.774** NS
	IRON (µg/dl)	66.45 ± 18.38	64.83 ± 15.7	5.87↓	0.82	**0.432** NS
	TIBC(µgm/dl)	332.52 ± 42.83	328.33 ± 39.9	0.86↓	0.49	**0.628** NS

**Significant at p<0.001,* Significant at p<0.05, NS- Not Significant

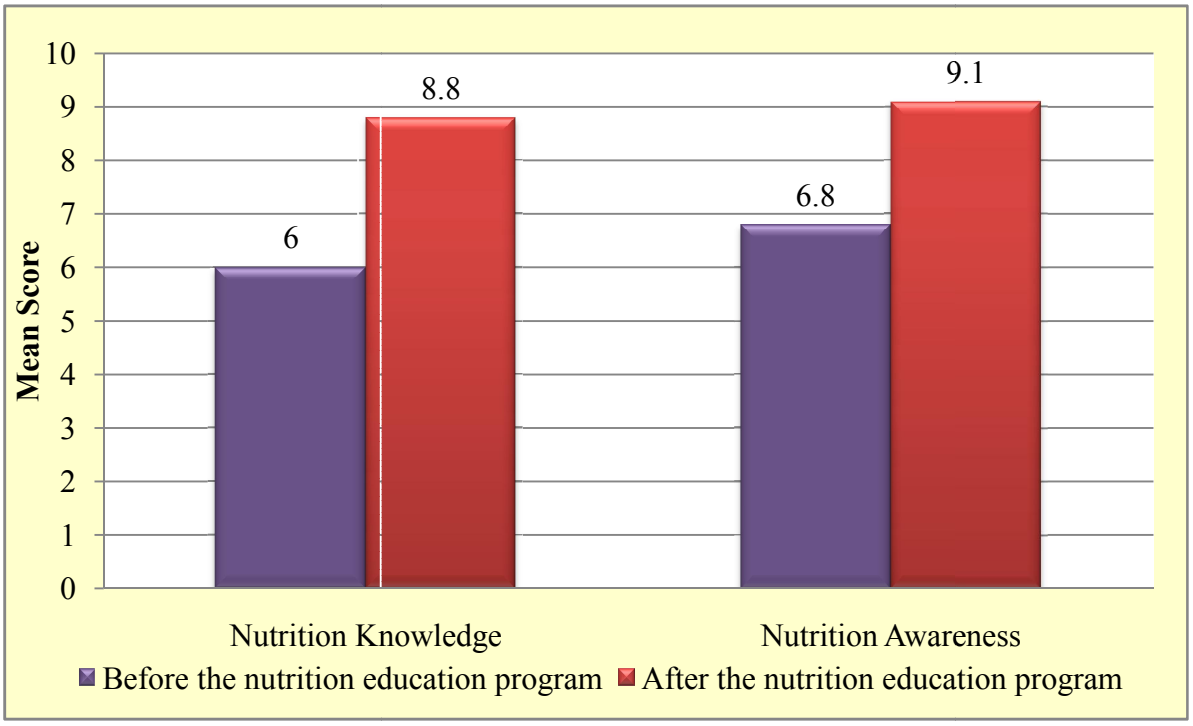

Figure 1: Mean score of nutrition knowledge and awarness before and after the nutrition education program

before and after supplementation. As observed in the table 3, Supplementation of Ragi vermicelli showed a significant 5.89 percent increase in the MCV (75.50 ± 4.47 to 79.87 ± 5.29 fL) and 6.53 percent increase in MCH (23.90 ± 1.26 to 25.44 ± 1.60) at the end of the supplementation period (p<0.001). The other hematological parameters did not show any significant change during the supplementation period. This could be due to the fact that RBC fully growth is 120 days and 45 days was inadequate to see any improvement, however there was a marginal increase in Hemoglobin and MCHC. Similarly MCV and MCH significantly increased in the control group after the study period, while the other hematological parameters did not show any significant change during the study period. Dietary interactions and proposed an algorithm for estimating dietary iron absorption, and the enhancing or inhibiting effects of other dietary components consumed concurrently (Hallberg and Hulthen, 2000).

Nutrition Education Program

As seen in Figure 1 the mean score on nutrition knowledge before the education program was found to be 6.0 ±2.4 on a maximum score of 10

and this increased to 8.75±1.8 after the nutrition education program. The mean score on nutrition awareness before the education program was found to be 6.79±2.6 on a maximum score of 10 and this had increased to 9.1±1.2 after the nutrition education program. This indicates nutrition education program was effective and useful and improved knowledge and awareness in nutrition among the Children. Results of the test of significance reveal that there is a significant increase at 1% level in nutrition knowledge and nutrition awareness among the Children after the nutrition education program ($P<0.001$).

Conclusion

Presence or absence of inhibitors in the consumed meal influences absorption of nonhaem iron. Cereals exhibit inhibition of dietary iron absorption due to the endogenous phytate contained in their outer coats. During food processing (e.g. fermentation and germination) and to a limited extent with the action of endogenous phytases in some cereals, phytic acid is dephosphorylated to yield lower inositol phosphates such as myoinositol bis-, tris-, and penta-phosphates (Torre *et al*., 1991). Removal of the phytate in bran by different methods increases iron absorption by approximately 3.5 times. Tatala *et al*., (2007) in his study on effect of germination of finger millet on anemia status in Tanzanian children found that After six months of supplementing children with the fortified beverage a significantly larger increase in hemoglobin concentration was shown in the fortified group than in the non-fortified group (a difference of 6.2 versus 3.2 g/dl respectively). Supplementing infants with the germinated cereal based food supplement showed a general improvement on Hb status and growth that was not significantly different to that in the control group ($P > 0.05$). Germination improves the nutritional value of foods however there is need to fortify such processed foods.

Prevalence of anemia is increasing among school children. Iron deficiency anemia is the most common nutritional deficiency in children thus the study aimed at supplementing developed recipes from Ragi Vermicelli. Ragi which is rich in iron is an extremely low cost nutritious cereal and is very beneficial for maintaining a good health. The children who had consumed this Ragi vermicelli had all liked the evening snacks and since results of the study indicate it is effective in marginal non significant increase of hemoglobin levels. The limitation of the study was a short duration of supplementation. The study can be extended for a period of 120 days (life time of RBC) to check the efficiency of Ragi in preventing the occurrence of iron deficiency anemia.

ACKNOWLEDGEMENT

Authors acknowledge the great help received from the scholars whose articles cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

Conflict of Interest: None declared.

REFERENCES

Hallberg L, Hulthen L. (2000) Prediction of dietary iron absorption: an algorithm for calculating absorption and bioavailability of dietary iron. Am J Clin Nutr; 1:1147–60.

Halterman JS, Kaczorowski JM, Aligne CA, Auinger P, Szilagyi PG. (2001) Iron deficiency and cognitive achievement among school-aged children and adolescents in the United States. Pediatrics. Jun; 107(6):1381-6.

Kotecha PV, (2011) Nutritional anemia in young children with focus on Asia and India. Indian J Community Med. Jan; 36(1):8-16.

Lozoff B, Beard J, Connor J, Barbara F, Georgieff M, Schallert T. (2006) Long-lasting neural and behavioral effects of iron deficiency in infancy. Nutr Rev. May; 64(5 Pt 2): S34-43.

Shobana S, Krishnaswamy K, Sudha V, Malleshi NG, Anjana RM, Palaniappan L, Mohan V. (2013) Finger millet (Ragi, Eleusine coracana L.): a review of its nutritional properties, processing, and plausible health benefits. Adv Food Nutr Res.; 69:1-39.

Sudhagandhi B, Sundaresan S, William W E, Prema A. (2011) Prevalence of anemia in the school children of Kattankulathur, Tamil Nadu, India. Int J Nutr Pharmacol Neurol Dis 1: 184-8.

Tatala S, Ndossi G, Ash D, Mamiro P. (2007) Effect of germination of finger millet on nutritional value of foods and effect of food supplement on nutrition and anaemia status in Tanzanian children. Tanzan Health Res Bull. May; 9(2): 77-86.

Tatala, S., Svanberg, U. and Mduma, B. (1998) Low dietary iron availability is a major cause of anemia. American Journal of Clinical Nutrition, 69: 171−178.

Torre, M., Rodriguez, A. & Saura-Calixto, F. (1991) Effects of dietary fiber and phytic acid on mineral bioavailability. Critical Review in Food Science and Nutrition. 1, 1-22.

WHO (2008). World-Wide Prevalence of Anemia, 1993 to 2005, World Health Organization, Geneva, Switzerland.

****