RESEARCH ARTICLE Asian Journal of Dairy and Food Research, Volume 43 Issue 1: 111-115 (March 2024)

Impact of Iron Rich Millet Biscuits in Alleviating Anaemia among Adolescent Girls of Samastipur District

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10.18805/ajdfr.DR-2071

ABSTRACT

Background: Iron deficiency anaemia (IDA) is the most common type of nutritional anaemia which affects people globally. Adolescent period symbolizes the initiating of menstrual period in girls hence, they are at a larger risk for nutritional anaemia. Supplementation, fortification and dietary diversification are the three initiatives for alleviating anaemia. Hence, this present investigation was undertaken with the objective to study the impact of millet based biscuits on haemoglobin level of adolescent girls of Samastipur district.

Methods: The haemoglobin level of selected forty adolescent girls aged 17-19 years from Uma Pandey College in Pusa block at Samastipur district were carefully examined before intervention study. Experimental adolescent girls who fell in the Hb level range of < 8 to 11.9 g/dl were intervened with 250 g of T_5 millet biscuit for a period of 45 days in order to complement 1/3rd of the regular need of iron for adolescent girls.

Result: The mean increase in haemoglobin level after intervention was found to be 1.24 g/dl in experimental girls which indicated the positive impact of millet biscuits on haematological health of anaemic adolescent girls. The present work will be a complementary contribution towards alleviating anaemia among adolescent girls.

Key words: Adolescent girls, Haemoglobin, Iron deficiency anaemia, Millet biscuits.

INTRODUCTION

Adolescence age which is considered between 10 to 19 years distinguished by distinct physical activity and rapid growth spurt. Adolescents have covered almost one fifth of population now-a-days in the world and their numbers are kept growing but most of them are undernourished (Yadav *et al*., 2017). Especially, adolescent girls form a crucial segment of the population and constitute, as it were, the vital "bridge" between the present generation and the forthcoming generation. At present, the frequency of anaemia among adolescent girls is on the hike in India mainly due to low socio-economic status and poor access of the health-care services. Anaemia is a state of haematological abnormalities which includes depletion in oxygen-carrying capacity or deduction in the proportion of healthy red blood cells of the body. Iron deficiency anaemia (IDA) is the most common type of nutritional anaemia which affects people globally. Specifically adolescent period symbolizes the initiating of menstrual period in girls hence, they are at a larger risk for nutritional anaemia. According to WHO (2019), globally 29.9 per cent of women aged 15-49 years suffered from anaemia. Among them 59.1 per cent of women aged 15-19 years in India were anaemic. In Bihar the prevalence of anaemia among all female aged 15-19 years was 65.0 per cent in which the prevalence rate of anaemia in rural area was 65.4 per cent. The prevalence rate of anaemia among all female aged 15-19 years in Samastipur district was 65.9 per cent (NFHS-5, 2019-20). Supplementation, fortification and dietary diversification are the three initiatives for alleviating anaemia. As a result, it is critical that locally accessible, affordable but high-nutritional-value materials should be employed as a catalyst to enhance the nutritional condition of teenage females. Millets and pseudocereals are considered as the best option to improve nutritional health due to abundance of dietary fibre and micro-nutrients present in them. Millets have significant nutraceutical and therapeutical properties like anti-diabetic, anti-hyperlipidaemic, anti-allergic for gluten sensitive persons, anti-carcinogenic, anti-inflammatory, anti-ageing, nephroprotective *etc*. It also helps in wound healing, strengthening the nervous system and increasing haemoglobin level (Chauhan and Sarita, 2018). Along with millets, some pseudocereals also gain their nutritional importance in present scenario due to abundance of proteins, phenolic acids, minerals, vitamins, amino acids, dietary fibres and unsaturated fatty acids (Pirzadah and Malik, 2020) which are helpful to human health. Despite all

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How to cite this article: Choudhury, S.S. and Chaudhary, G. (2024). Impact of Iron Rich Millet Biscuits in Alleviating Anaemia among Adolescent Girls of Samastipur District. Asian Journal of Dairy and Food Research. 43(1): 111-115. doi: 10.18805/ajdfr.DR-2071.

Submitted: 18-01-2023 **Accepted:** 16-06-2023 **Online:** 06-07-2023

the nutritional qualities present in millets and pseudocereals, certain anti-nutritional factors like phytates and tannins are also present in them which are minimized by different processing methods like soaking, germination *etc*. As very few studies were conducted on nutritional importance of coarse grains to prevent anaemia in Bihar, this present investigation was undertaken with the objective to study the impact of millet based biscuits on haemoglobin level of adolescent girls of Samastipur district.

MATERIALS AND METHODS

Locale of study

The study was conducted at the Department of Food and Nutrition, College of Community Science, Dr. Rajendra Prasad Central Agricultural University, Pusa in Samastipur district of Bihar during the period of May till August.

Selection of study subject

A total of forty adolescent girls aged 17-19 years were purposively selected from Uma Pandey College in Pusa block at Samastipur district.

Collection of data

Before intervention a systematic interview schedule was structured to know about their general and socio-economic information, their nutritional knowledge on millets and their value-added products, their knowledge on anaemia. Apart from this, assessment of their nutritional status was also carried out which included dietary assessment, anthropometry, biochemical evaluation (Hb test by using Sahli's technique).

Methods of preparation of millet biscuits

Millet flour and amaranth seed flour were more beneficial with reference to micronutrients content when included in bakery products, so it was planned to incorporate both to develop baked products in order to eliminate our complete reliance on wheat. The millet grains, *i.e*., pearl millet (Pusa hybrid 1202), foxtail millet (Rajendra kauni 1) and finger millet (RAV 8) along with amaranth seeds (GA-1) each of 1 kg were used to develop the products. After cleaning and washing, the entire millet grains were soaked for 12 h. After soaking pearl millet was germinated for 72 h, finger millet and foxtail millet were germinated for 48 h for development of millet flour based on some relevant reviews of the literature. After germination, all the grains were sun-dried and grinded to fine flour through domestic chakki. Other than that, amaranth seeds were cleaned and grinded to fine flour. Then the total amount of flour was sieved through 80 mesh size and kept in an air tight container separately at room temperature for future use. Different baked products like bread, buns, muffins, biscuits were tried to develop by combining millet flour and cereal flour. Among all the developed baked products, biscuits were accepted organoleptically by the panel members. Therefore, biscuits were taken for further investigation. In contrast to millet flour and amaranth flour; wheat flour, jaggery, powdered sugar, unsalted butter, cardamom powder, baking powder and baking soda were used for the development of biscuits. These ingredients were selected because they were locally available and affordable whereas jaggery was preferred due to its high iron content. After this, considerable attempts were undertaken to standardize the developed biscuits.

In this present investigation, five different types of millet biscuits were developed by taking wheat flour as control. Selected food ingredients with various proportions used for standardization were given in Table 1. A schematic diagram for preparation of millet biscuits was given in Fig 1.

Intervention of millet biscuits among adolescent girls

T_5 millet biscuit that comprised of 10:10:2.5:7.5:20 ratio of wheat flour, pearl millet flour, foxtail millet flour, finger millet flour, amaranth seed flour achieved highest values in terms of nutritional evaluation with special reference to iron content and selected for intervention study. The haemoglobin level of selected forty adolescent girls were carefully examined before intervention study. Based on their haemoglobin level, they were split into two groups *i.e*. experimental group (30) and control group (10). Experimental adolescent girls who fell in the Hb level range of < 8 to 11.9 g/dl were intervened with 250 g of T_5 millet biscuit for a period of 45 days in order to complement 1/3rd of the regular need of iron for adolescent girls. Impact of intervention on their weight, height, BMI and haemoglobin level was taken into consideration at the end of 45 days and placed them in normal, mild, moderate, or severe anaemic according to their post-haemoglobin level. In case of control group no intervention was given. The data obtained from the various analyses was statistically analyzed in accordance with the objective of the research. Paired t-test was used to know the impact of millet-biscuits on anthropometry and haemoglobin level of adolescent girls at 5 per cent level of significance.

RESULTS AND DISCUSSION

Assessment of the nutritional status of adolescent girls

On the basis of food habits it had been observed that most of the respondents were vegetarian. The results showed that in terms of meal pattern, few respondents were eating meal two times per day. Further it was demonstrated that although majority of the respondents had knowledge on nutrition, only few of them were aware about the nutritional importance of millets. The entire population were preferred to include millets in their diet due to its high nutritional values, fibre content, better taste and flavour and so on. All the participants preferred to consume bakery products such as cookies, cake, bread due to its better taste and flavour according to the data on the varieties of bakery products. It was clear from the result that no one was aware about the availability of millet-based baked products in the market. Additionally, it was observed that 100 per cent respondents showed interest in buying millet-based baked products from the market. Furthermore, the largest part of

especially iron in human body. Nearly, substantial percentage of respondents were aware about iron-rich foods. It was also evident from the study that most of the girls were unaware about the daily iron requirements of adolescent girls *i.e.* 32 mg. According to the findings, none of them had knowledge about millet-based iron-rich food products. The results also highlighted that 100 per cent of participants from both the experimental group and the control group were interested in consuming iron-rich millet-based products. Based on the food intake pattern of adolescent girls, they were unable to meet the per cent adequacy level suggested by RDI with respect to all the food groups. Regarding nutrient intake pattern of adolescent girls it was observed that consumption of iron and zinc was low whereas their likeness towards the consumption of cereals, starch-based foods, roots and tubers was high.

Impact of millet-based biscuits on anthropometric measurements and haemoglobin level of adolescent girls

The data presented in the Fig 2. suggested that before supplementation, the mean weight of adolescent girls in the experimental group was observed to be 43.83 kg which was increased to 44.26 kg after supplementation, which indicated a significant increase ($p<0.05$) of weight *i.e.*, 0.43 kg. But a non-significant difference ($p<0.05$) was present between the mean weight of the control group. It was observed that there were no significant differences ($p<0.05$) present between mean height of selected adolescent girls in both the group before and after intervention of millet biscuits. A significant increase ($p<0.05$) in BMI of experimental group *i.e.* 0.18 kg/m^2 was observed while a non-significant difference ($p<0.05$) was found in case of control group.

Fig 3 indicated that the mean initial level of haemoglobin in experimental group was 9.11 g/dl which increased significantly ($p<0.05$) to 10.35 g/dl after 45 days supplementation of iron-rich millet biscuits. But a non-significant increase ($p<0.05$) of haemoglobin level was observed in control group. The mean difference of haemoglobin level before and after intervention was found to be 1.24 g/dl for experimental girls whereas for control girls only 0.07 g/dl increment was observed. The mean

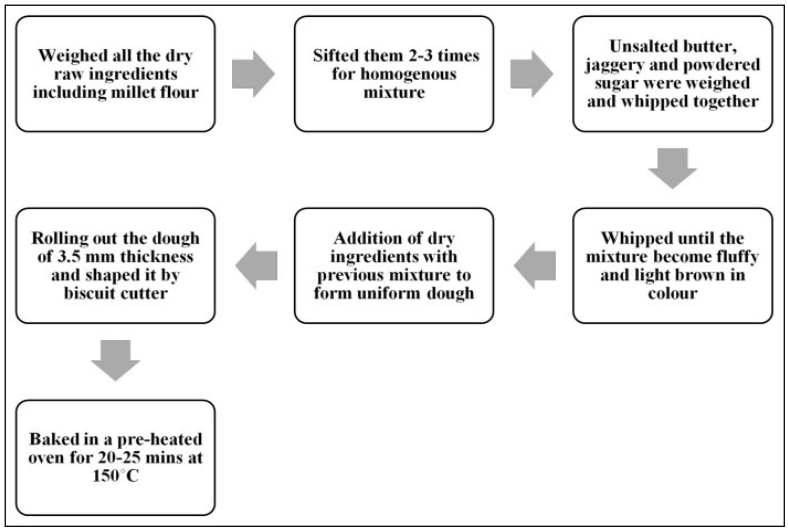


Fig 1: Schematic diagram for preparation of millet biscuits.

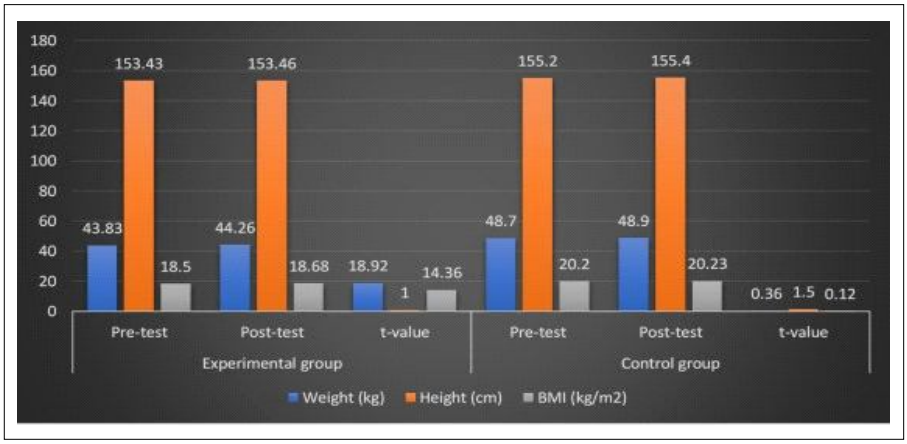


Fig 2: Impact of intervention on anthropometric measurements of adolescent girls.

increase in haemoglobin level indicated that iron-rich millet biscuits had a positive impact on the haematological health of anaemic adolescent girls. This similar value was also seen in the study of Gore (2015), who assessed the impact of value-added bajra products by supplementing 50 g pearl pop chiwada (Pearl pop: Roasted bengal gram dhal: Rajgira leaves powder: Mango powder in 30: 14:1:1.5) for 60 days on a daily basis among 30 moderate anaemic adolescent girls. The results revealed that there was an increase of 1.18 g/dl in Hb level after supplementation.

Impact of nutritional intervention on prevalence of anaemia among selected adolescent girls

At last, from Table 2. It was depicted that 73.34 per cent and 26.67 per cent subjects were fell into the category of moderate anaemic and severe anaemic respectively before the intervention of millet biscuits. After 45 days of intervention, it was observed that 26.67 per cent severe anaemic subjects advanced to the moderate anaemic category, 43.33 per cent respondents of moderate anaemic group were shifted to the mild anaemic group and 30 per cent

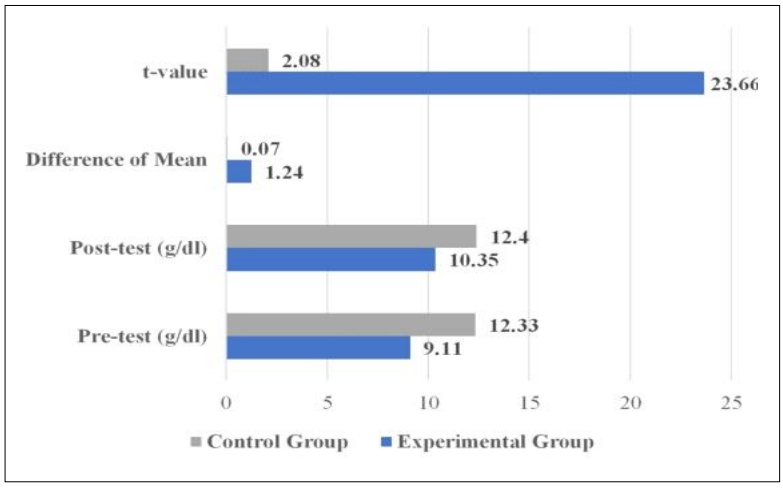


Fig 3: Impact of intervention on haemoglobin level of adolescent girls.

Table 1: Formulation of millet biscuits.

Treatments	C	T_1	T_2	T_3	T_4	T_5
Wheat flour (g)	50.00	25.00	30.00	15.00	15.00	10.00
Pearl millet flour (g)	-	5.00	7.50	7.50	10.00	10.00
Foxtail millet flour (g)	-	5.00	2.50	2.50	-	2.50
Finger millet flour (g)	-	15.00	10.00	10.00	10.00	7.50
Amaranth seed flour (g)	-	-	-	15.00	15.00	20.00
Unsalted butter (g)	25.00	25.00	25.00	25.00	25.00	25.00
Jaggery (g)	12.50	12.50	12.50	12.50	12.50	12.50
Powdered sugar (g)	10.00	10.00	10.00	10.00	10.00	10.00
Cardamom powder (g)	2.50	2.50	2.50	2.50	2.50	2.50
Baking powder (g)	0.30	0.30	0.30	0.30	0.30	0.30
Baking soda (g)	0.30	0.30	0.30	0.30	0.30	0.30
Total (g)	100.60	100.60	100.60	100.60	100.60	100.60

Table 2: Impact of nutritional intervention on prevalence of anemia among selected adolescent girls.

Hemoglobin level (g/dl)	Experimental group (30)				Control group (10)			
	Pre-test		Post-test		Pre-test		Post-test	
	N	%	N	%	N	%	N	%
≥12 (Non-anemic)	-	-	-	-	10	100	10	100
11-11.9 (Mild-anemic)	-	-	13	43.33	-	-	-	-
8-10.9 (Moderate-anemic)	22	73.34	17	56.67	-	-	-	-
<8 (Severe-anemic)	8	26.67	-	-	-	-	-	-

ended up remaining in the category of moderate anaemic, however the range of haemoglobin levels increased positively after intervention. Throughout the intervention period, the non-anaemic level of control group remained relatively constant, but they did not receive any kind of supplementation. Several studies conducted in India have revealed that the anaemia is pervasive in our nation which appears to be triggered mostly by inadequate food intake and poor iron absorption from cereal-based vegetarian diets resulting in nutritional anaemia.

The findings of Chaudhary and Gupta (2021) revealed that the impact of nutri-rich ladoo and mathri prepared with amaranth seed, garden cress seed, sesame seed of 20 g per day over a period of four months improved haemoglobin level by 1.46 g/dl of 90 moderately anaemic adolescent girls. Khosla and Nayak (2020) supplemented two finger millet ladoo (50 g each) daily for four consecutive weeks to young females of age group 17-19 years staying at the hostel. Further they revealed that consumption of finger millet had a significant effect on the haemoglobin level of anaemic young females.

CONCLUSION

The strategy to adopt nutritional diversity and the addition of natural iron-rich foods in diets without the possible negative consequences of synthetic additions helps to eradicate nutritional anaemia. The adolescent girls were informed and encouraged to increase their intake of vitamin-C rich fruits and green leafy vegetables for better iron absorption. The mean increase in haemoglobin level after intervention of T_5 millet biscuit for a period of 45 days was found to be 1.24 g/dl in experimental girls which indicated the positive impact of millet-biscuits on haematological health of anaemic adolescent girls.

ACKNOWLEDGEMENT

I am thankful to Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar for providing infrastructure and financial support for the study.

Conflict of interest

The authors declare that there are no conflicts of interest in the course of conducting the research. All the authors had final decision regarding the manuscript and decision to submit the findings.

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