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FORMULATION AND SENSORY EVALUATION OF IRON RICH RECIPES USING GARDEN CRESS SEEDS (LEPIDIUM SATIVUM)

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Iron deficiency anemia is one of the common nutritional problems affecting millions of people in both developing and developed countries. Dietary intervention approach is an effective method to combat iron deficiency anemia. Garden cress belongs to Brassicaceae family. The seeds are excellent source of iron, 100gm of seeds provide 100 mg of iron. The present study was planned to develop four iron rich recipes viz. ladoo, mathri, shakkarpure and biscuits for adolescent girls using garden cress as the main ingredient. Three formulations of each recipe, i.e., control (no garden cress flour), variant-1 (unprocessed garden cress flour) and variant-2 (processed garden cress flour) were developed. The recipes were subjected to sensory evaluation using 9 point hedonic scale rating method. The overall acceptability of variant-2 of ladoo (7.80) and mathri (7.93) was rated higher, when compared. All sensory attributes were significantly higher in ladoo and mathri as compared to other developed products. Thus, it can be concluded that ladoo and mathri prepared with the incorporation of processed garden cress flour (soaked+dried+roasted) gave better sensory scores in recipes besides increasing the iron content. This can improve iron status among adolescent girls and enhances the iron intake of the diets consumed by adolescent girls.

Keywords: Garden cress seeds, Anemia, Sensory evaluation, Dietary intervention, Adolescent girls

INTRODUCTION

Iron deficiency anemia is one of the common nutritional problems affecting millions of people in both developing and developed countries. There is substantial evidence that anemia in children is associated with decreased physical and mental development, impaired immune function and reduced capacity of leucocytes to kill microorganisms. Globally, anemia affects 1.62 billion people, which corresponds to 24.8% of the population (WHO, 2009).

According to the UNICEF (2012) iron deficiency anemia affects over 60% of the adolescent girls in India. According to DLHS-3 survey in Himachal Pradesh, 43% women and 55% children are anemic. Adolescence is a vulnerable period in human life cycle when nutritional requirements increases

due to rapid growth spurt. Iron deficiency not only reduces work productivity but also accentuates the problem further during pregnancy.

Garden cress is an annual herb which is native to Egypt and Asian but is widely cultivated in hot temperate climates throughout the world for various culinary and medical uses (Malleshi and Guo, 2004). Garden cress is commonly referred to as *chandrashoor* in local Indian language. In India it is mainly cultivated in UP, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh (Kirtikar and Basu, 1935). The health benefits of garden cress seeds have been recognized for decades now. It is an important source of iron, folic acid, calcium, vitamin C, E and A. It is the richest source of iron containing 100 mg of iron for 100

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g of seeds (Gopalan *et al.*, 2009; and Elizabeth and Poojara, 2014). Garden cress seeds also provides good amount of carbohydrate, calories and protein containing 33 g, 454 kcals and 25.3 g respectively and contains good amounts of PUFA. Incorporation of garden cress seed in foods have shown marked increased in the iron and protein content (Nathiya and Nora, 2014).

Country experience with decades of iron supplementation programme has been less than satisfactory with the levels of iron and had little impact to reducing anemia (Uma and Sucharitha, 2016). There is interest turning to diet intervention approaches that have higher potential for achieving far-reaching and long lasting benefits for the control of iron deficiency. Strategies for improving anemia include supplementation, fortification and improvement in the diet. Therefore, it is essential that locally available materials which are inexpensive but highly nutritious be used as a vehicle to improve the nutrition status for adolescent girls.

With this is in a study was done to develop and standardize iron rich recipes for adolescent girls by modification of recipes that are popular among them with the incorporation of iron rich garden cress seeds.

MATERIAL AND METHODS

Development of Food Product

After trials of various recipes enrichment and prototypes, development was taken up for the recipes with higher acceptability. Three iron enriched variants each of *ladoo*, *mathri*, *shakkarpore* and biscuits were prepared. The first recipe of each product was control, i.e., garden cress was not incorporated and was developed for comparison. Variant-1 was subjected to incorporation of un-processed garden cress seed. Variant-2 was subjected to incorporation of processed garden cress seed.

After a series of trials using ingredients in various proportions and adopting different processing methods, the concept of the enriched products took shape (Table 1). These recipes were prepared in Food Science, Nutrition and Technology laboratory at CSKHPKV, Palampur.

Garden cress seed were chosen for iron enrichment along with other ingredients viz. amaranth seed and sesame seed to prepare *ladoo*, *mathri*, *shakkarpore* and biscuits and to find out the best one iron rich recipe among developed products by sensory acceptability.

Collection of Material

Raw material such as garden cress seeds, amaranth seeds, sesame seeds, wheat flour, refined flour and other raw materials were collected in bulk from local market.

Processing of Samples

Unprocessed Garden Cress (UP): Garden cress seeds were sorted and cleaned to remove impurities and were ground in mixer and stored in airtight container.

Processed Garden Cress (P): Garden cress seeds were sorted and cleaned to remove impurities. Seeds were soaked in water for 3 hours and drained the superficial water. After that, seeds were dried in tray drier at 60^o temperature and kept for drying until they completely dried. Then they were ground in mixer. Grounded flour was roasted and stored in airtight container.

Amaranth seeds were popped and made into fine flour and also stored in airtight container. Sesame seeds were roasted and coarsely grounded at the time of preparation of recipes.

Sensory Evaluation

All the developed food preparations were presented to a panel of ten semi-trained judges comprising faculty members and post graduate students, who evaluated organoleptically the presented food preparations using nine point Hedonic scale with corresponding descriptive terms ranging from 9 (like extremely) to 1 (dislike extremely).

Statistical Analysis

The data obtained from sensory evaluation were statistically analyzed by using analysis of variance technique (ANOVA). Significant difference between the variants was determined by using CD (critical difference test). Level of significance was accepted at $p \leq 0.05$.

RESULTS AND DISCUSSION

Food fortification is successful because it makes frequently eaten foods more nutritious without relying on individuals to change their habits and Iron fortification of food is a methodology utilized worldwide to address iron deficiency. The iron content standardized for 100 grams of all developed products calculated and presented in the Table 2. The highest content of iron was found in *ladoo* and *mathri* at variant-1 (20.37 mg/100 gm and 20.32 mg/100 g) with percent increase 72.41 and 66.73 and minimum in *shakkarpore* (16.80 mg/100 gm and 13.30 mg/100 g). The percent increase in

Table 1: Recipes Standardized Ingredients Used

Recipe	Control	Variant-1	Variant-2
<i>Ladoo</i>	Amaranth flour-25 g	Amaranth flour-25 g	Amaranth flour-10 g
	Wheat flour-25 g	Wheat flour-20 g	Wheat flour-10 g
	Jaggery-40 g	Jaggery-40 g	Jaggery-40 g
	Fat-10 g	Fat- 10 g	Fat-10 g
		Garden cress flour (UP)-10 g	Garden cress flour (P)-10 g
			Sesame seeds-15 g
			Grated coconut-5 g
<i>Mathri</i>	Refined flour-25 g	Refined flour-40 g	Refined flour-50 g
	Amaranth flour-30 g	Amaranth flour-30 g	Amaranth flour-20 g
	Fat-20 g	Garden cress flour (UP)-10 g	Gardencress flour (P)-10 g
		Fat-20 g	Sesame-16 g
			Dry Fenugreek leaves-1 g
			Fat-20 g
<i>Shakkarpore</i>	Refined flour-60 g	Refined flour-40 g	Refined flour-30 g
	Sugar-30 g	Amaranth flour-10 g	Amaranth flour-20 g
	Amaranth flour-10 g	Garden cress flour (UP)-10 g	Garden cress flour (P)-10 g
		Sugar-30 g	Sugar-30 g
			Sesame seeds-10 g
<i>Biscuit</i>	Refined flour-50 g	Refined flour -45 g	Refined flour-40 g
	Amaranth flour-10 g	Amaranth flour-5 g	Amaranth flour-10 g
	Fat-30 g	Garden cress flour (UP)-10 g	Garden cress flour (P)-10 g
	Salt-1 g	Fat-30 g	Fat-30 g
	Sugar-4 g	Salt-1 g	Salt-1 g
	Onum-2 g	Sugar-4 g	Sugar-4 g
	Cumin-2 g	Onum-2 g	Onum-2 g
	Baking powder-0.30 g	Cumin-2 g	Cumin-2 g
	Baking powder-0.30 g	Baking powder-0.30 g	

Table 2: Iron Content (mg/100 g) and Percent Increase of Iron Rich Recipes

<i>Ladoo</i>		
Control	Variant-1	Variant-2
5.62	15.36	20.37
Percent increase	65.75	72.41
<i>Mathri</i>		
Control	Variant-1	Variant-2
6.76	16.2	20.32
Percent increase	58.27	66.73
<i>Shakkerpare</i>		
Control	Variant-1	Variant-2
3	12.3	16.8
Percent increase	75.6	82.14
<i>Biscuits</i>		
Control	Variant-1	Variant-2
2.9	12.3	13.3
Percent increase	76.42	78.19

Note: Iron values calculated using - NIN.

Source: Nutritive values calculated by Gopalan et al. (2009), Nutritive Value of Indian Foods

iron content higher in variant-2 of *ladoo*, *mathri*, *shakkerpare* and biscuits, i.e., 72.41, 66.73, 82.14 and 78.19 respectively. Incorporation of garden cress seeds in recipes have shown marked increased in the iron content. It was observed that more than 75% iron RDA for Indians – adolescent girls (NIN, 2010) was provided by 100 g of *ladoo* and *mathri*. The results supported by Uma and Sucharitha (2016) they found that garden incorporation in recipes increase iron content as compared with standard recipe and the iron content of five traditional Indian food preparations increased enormously by incorporation of garden cress seeds and per cent increase maximum at roasted garden cress seeds by Kaur and Sharma (2015).

Sensory Evaluation of Ladoo

Table 3 shows the mean scores of *ladoo* in relation to colour which indicates that variant-2 had the highest score (8.12) followed by control (7.84) and variant-1 (7.22) respectively.

Descriptive term for colour shows that variant-2 was 'liked very much' while control and variant-1 were 'liked moderately' by the panel of judges. The mean scores in relation to taste, flavour and texture was again calculated higher for variant-2 followed by control and variant-1 respectively indicating that variant-2 gave the best taste, flavor and texture to *ladoo*. It was seen that addition of 10 g processed garden cress flour in the variant-1 improved acceptability of *ladoo*. Significant difference was observed between the treatments indicating that the addition of processed and un-processed garden cress flour affected the appearance and colour of the *ladoo*, the colour becomes lightly darker and more acceptable.

In relation to taste, significant difference between the three treatments revealed that incorporation of garden cress flour affected taste. Processed garden cress flour in variant 2 reduced the pungency and there by increased the taste while un-processed garden cress flour in variant-1 decreased the taste due to pungent taste and litter bitterness.

Significant difference was again observed between the variants and control for flavour and texture indicating that the addition of processed and un-processed garden cress flour too affected the flavour and texture of *ladoo*. Flavour became more acceptable as processed garden cress flour was added because the peppery aromatic flavor of garden cress seed, being volatile in nature reduced during processing. The texture became fragile, crispy and more acceptable in variant 2 *ladoo* because the mucilage produced during soaking of seeds imparted the desirable textural characteristics.

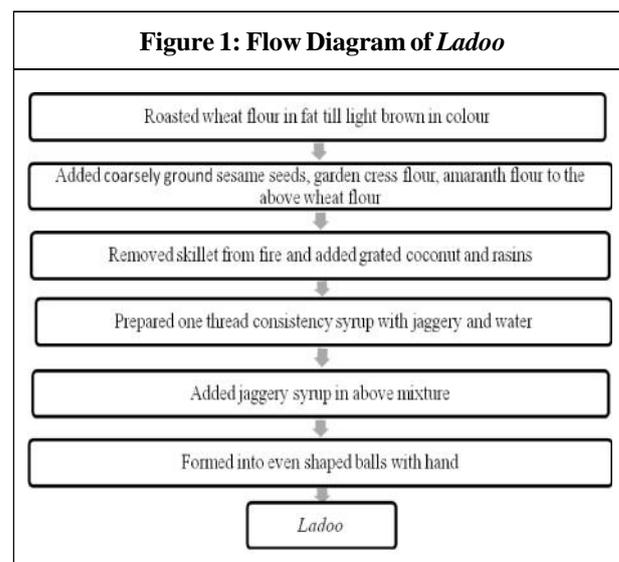


Table 3: Sensory Evaluation of Control Recipes and Iron Rich Recipes

Recipes		Treatments			
		Control	Variant-1	Variant-2	Mean
<i>Ladoo</i>	Colour	7.84	7.22	8.12	7.73
	Taste	7.77	7.65	7.8	7.74
	Flavour	7.78	6.71	7.83	7.44
	Texture	7.25	7.16	7.44	7.28
	Mean	7.66	7.19	7.8	7.55
	Factors	Attributes (A)	Variant (B)		A×B
	CD(p≤0.05)	0.02		0.02	0.04
<i>Mathri</i>	Colour	7.94	6.94	8.02	7.64
	Taste	7.46	6.71	7.91	7.36
	Flavour	7.56	6.48	7.68	7.24
	Texture	7.97	6.48	8.1	7.52
	Mean	7.73	6.65	7.93	7.44
	Factors	Attributes (A)	Variant (B)		A×B
	CD(p≤0.05)	0.01		0.01	0.03
<i>Shakkarpare</i>	Colour	7.51	6.32	7.03	6.95
	Taste	7.23	6.1	6.75	6.69
	Flavour	7.14	5.97	6.83	6.65
	Texture	7.64	6.12	6.72	6.83
	Mean	7.38	6.13	6.83	6.78
	Factors	Attributes (A)	Variant (B)		A×B
	CD(p≤0.05)	0.02		0.02	0.04
<i>Biscuits</i>	Colour	7.64	6.03	6.11	6.59
	Taste	7.66	5.89	6.1	6.55
	Flavour	7.61	5.87	6.04	6.51
	Texture	7.57	5.96	6.61	6.71
	Mean	7.62	5.94	6.21	6.59
	Factors	Attributes (A)	Variant (B)		A×B
	CD(p≤0.05)	0.03		0.03	0.06

Note: Maximum possible score: 9.

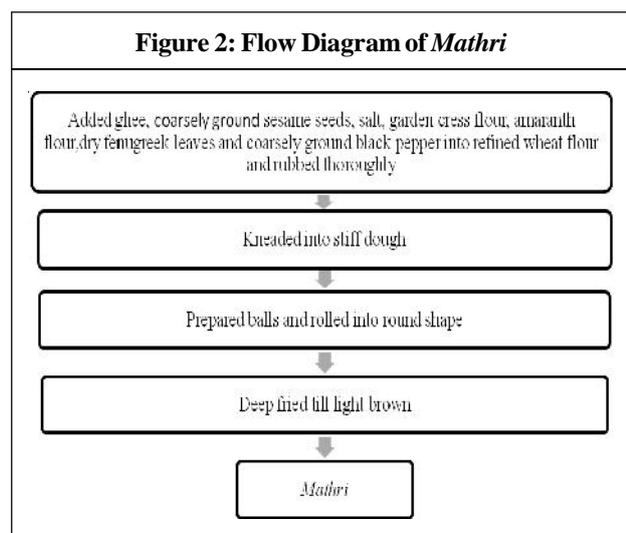
The findings of the present study are in favour with the previous studies. Kaur and Sharma (2015) worked on

enrichment of five traditional Indian food preparations namely, *atta besan ladoo*, *shakarpara*, *chikki*, *mathri* and

matrey with treated garden cress seeds. The results showed that up to 10% incorporation of garden cress flour in food preparations were highly acceptable in roasted treatment as compared to soaked overnight treatment. The *ladoo* gained highest scores for all sensory attributes when 10 g garden cress flour incorporated against the 15 g incorporation (Uma and Sucharitha, 2016). Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions of 5%, 10% and 15%. All supplemented products were accepted as desirable to moderately desirable in terms for all sensory parameters and at 10% supplementation proportion was most desirable as compared to 5% and 15% proportions.

Sensory Evaluation of Mathri

Table 3 shows the mean scores of *mathri* in relation to colour which indicates that variant-2 had the highest score (8.02) followed by control (7.94) and variant-1 (6.94) respectively. Descriptive term for colour shows that variant-2 and control were 'liked very much' while variant-1 was 'moderately liked' by the panel of judges. The mean scores in relation to taste, flavour and texture was again calculated higher for variant-2 followed by control and variant-1 respectively indicating that variant-2 gave the best taste, flavour and texture to *mathri*. It was seen that addition of 10g processed garden cress flour in the variant-2 improved acceptability of *mathri*. Significant difference was observed between the treatments indicating that the addition of processed and un-processed garden cress flour affected the appearance and colour of the *mathri*, the colour becomes golden brown and more acceptable.



Significant difference between the three treatments revealed that incorporation of garden cress flour affected taste. Processed garden cress flour in variant 2 reduced the pungency and there by increased the taste while un-processed garden cress flour in variant-1.

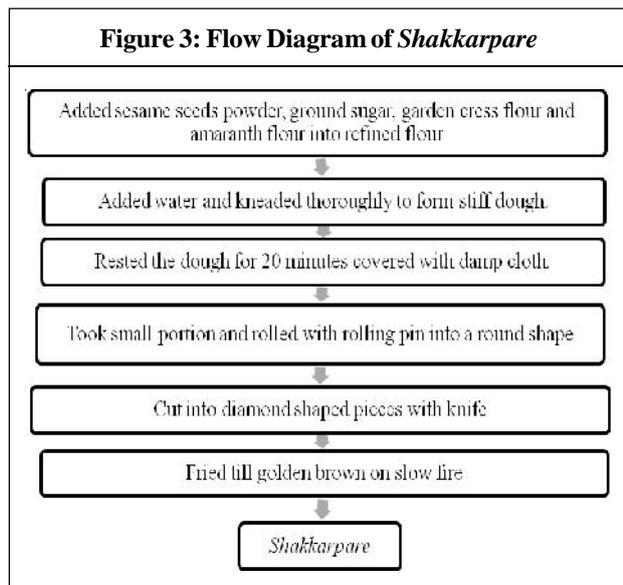
Significant difference was again observed between the variants and control for flavour and texture indicating that the addition of processed and un-processed garden cress flour too affected the flavour and texture of *mathri*. Flavour became more acceptable as processed garden cress flour was added because reduction in its peppery aromatic flavor during processing. In lines with *ladoo*, the texture becomes fragile, crispy and more acceptable in variant 2 *mathri*.

The results were found in lines with earlier findings. Agrwal and Sharma (2013) performed an experiment on garden cress seed with different processing methods (roasted, microwaved and whole) and used them for incorporation in *mathri*. Addition of 5% level of all treated garden cress seed powder was rated "desirable" by the panel of 15 judges. The *mathri* scored highest with regard to all sensory attributes, when 20% incorporation of amaranth seeds and 10% watermelon seeds was done by Virginia *et al.* (2014). The results (Kaur and Sharma, 2015) of showed that up to 10% incorporation of garden cress flour in five traditional Indian developed food preparations were highly acceptable for roasted treatment as compared to soaked overnight treatment.

Sensory Evaluation of Shakkarpore

Table 3 shows the mean scores of *shakkarpore* in relation to colour which indicates that control had the highest score (7.51) followed by variant-2 (7.03) and variant-1 (6.32) respectively. Descriptive term for colour shows that control and variant-2 were 'liked moderately' while variant-2 was 'liked slightly' by the panel of judges. The mean scores in relation to taste, flavour and texture was again calculated higher for control, variant-2 and variant-1 which indicating that addition of garden cress flour reduced the acceptability of *shakkarpore* when compared to control.

In relation to colour, taste, flavour and texture, significant difference between the three treatments revealed that incorporation of garden cress seed flour in processed and un-processed form affected sensory attributes. Due to darker colour, pungent taste, peppery aromatic flavor and slightly hard texture brought down the sensory scores and incorporation of garden cress was not liked by judges for



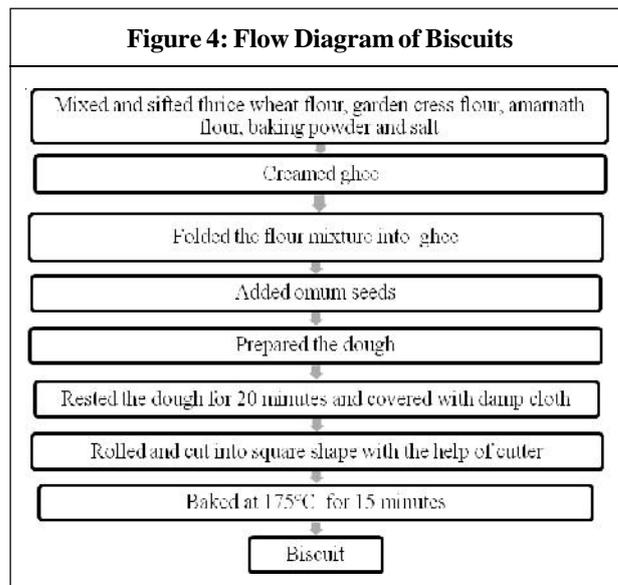
shakkarpare. Descriptive analysis of results for all variants was 'liked moderately' to 'liked slightly'.

The results of present study corroborated with findings of Singh and Srivastava (2012) who formulated iron rich *namakpare* mixes and reported finger millet up-to 60% can be successfully incorporated. Kaur and Sharma (2015) worked on enrichment of five traditional Indian food preparations namely, *atta besan laddoo*, *shakarpara*, *chikki*, *mathri* and *matrey* with treated garden cress seeds. The results showed that up to 10% incorporation of garden cress flour in food preparations were highly acceptable for roasted treatment as compared to soaked overnight treatment.

Sensory Evaluation of Biscuits

Table 3 shows the mean scores of biscuits in relation to colour which indicates that control had the highest score (7.64) followed by variant-2 (6.11) and variant-1 (6.03) respectively. Descriptive nomenclature for colour shows that the control was 'liked moderately' while variant-1 and variant-2 were 'liked slightly' by the panel of judges. The mean score of biscuits in relation to taste, flavour and texture was again calculated higher for control and slightly less in variant-2 and variant-1 which indicating that addition of garden cress reduces the sensory scored of biscuits as compared with control.

In relation to colour, taste, flavour and texture, significant difference between the three treatments revealed that incorporation of garden cress seed flour in processed and un-processed form affected sensory attributes. Like *shakkarpare* darker colour, pungent taste and flavor



brought down the sensory scores and incorporation of garden cress did not liked by judges for biscuits and were rated as 'liked moderately' to 'liked slightly'.

Results with similar and with slight variations have been reported by Patil *et al.* (2015) prepared biscuits by the using garden cress seed at 05, 10, 15 and 20% level. On the basis of overall sensory attributes, 100: 10 proportion got higher score than sample 100:05 and 100:15%. Rana and Kaur (2016) prepared supplemented products viz. biscuits, *laddoo* and *namakpare* with garden cress seeds using proportions of 5%, 10% and 15%. All supplemented products were accepted as desirable to moderately desirable in terms for all sensory parameters and at 10% supplementation proportion was most desirable as compared to 5% and 15% proportions.

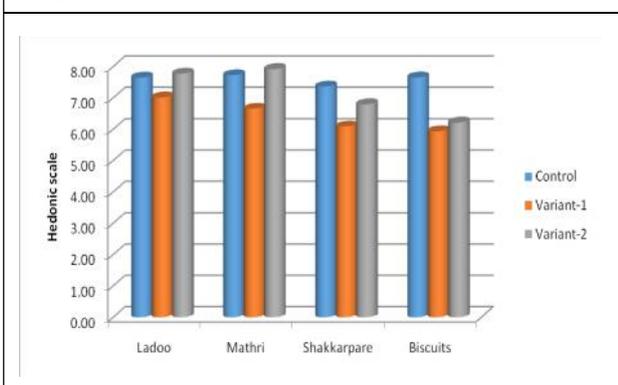
Overall Acceptability of Iron Rich Recipes

The overall acceptability scores of iron rich recipes depicted in Figure 5. In *laddoo* variant-2 secured highest sensory scores (7.77) as compared with control and variant-1 having average scores 7.64 and 7.01 respectively. The variant -2 in *mathri* also secured highest followed by control and variant-1 with mean scores 7.91, 7.72 and 6.65 respectively which may be ascribed due to incorporation of processed garden cress flour in *laddoo* and *mathri* increase overall acceptability. The overall acceptability score of *shakkarpare* and biscuits shows that control scored highest followed by variant-2 and variant-1 respectively. The sensory score slightly declined when garden cress was incorporate in *shakkarpare* and biscuits.

All the iron rich recipes viz. *ladoo*, *mathri*, *shakkarpare* and biscuit had mean sensory scores of 7.55 (like moderately), 7.44 (like moderately), 6.59 (like slightly) and 6.78 (like slightly), respectively. Among various developed

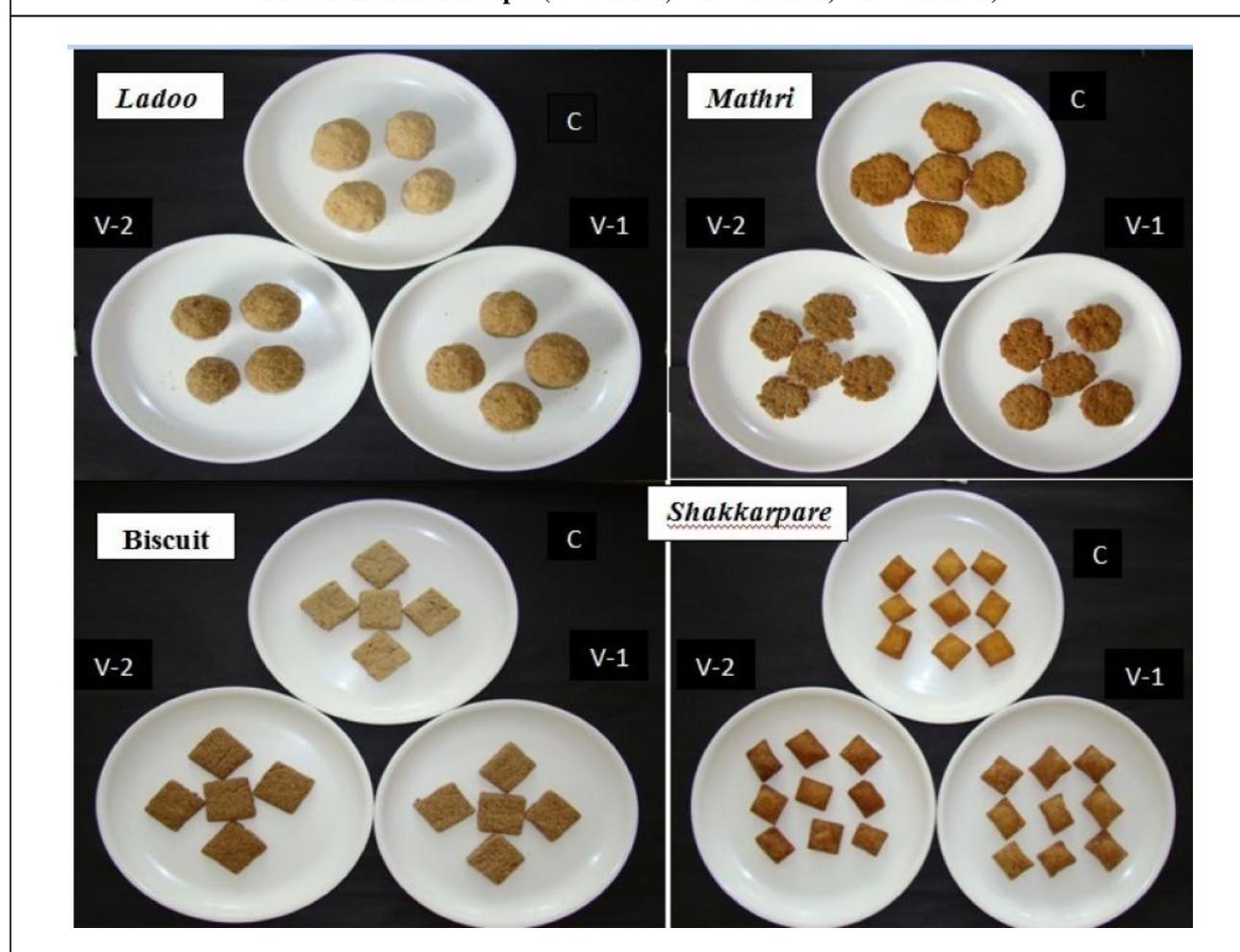
recipes and its variants, *ladoo* and *mathri* scored highest for its variant-2 where as control treatment of *shakkarpare* and biscuit were.

Figure 5: Overall Acceptability of Iron Rich Recipes



Reviews relevant to present study Angel and Devi (2014) formulated and developed cheapest nutritious iron rich health mix with garden cress seeds. In the mix they stated that 5 g incorporation of garden cress seeds is acceptable. Elizabeth and Poojara (2014) developed ten recipes with the incorporation of garden cress seeds. Incorporation of 10g of garden cress seeds was acceptable in sixty percent of the developed snacks. Sharma (2015) studied the acceptability of germinated garden cress seeds by incorporating into the food consumed daily like sandwich, raita, soups and salads. The incorporate level of germinated seeds varied from 7-30% of seeds into the above recipes, and stated that samples prepared with 10-15% of garden cress seeds was most acceptable.

Plate 1: Iron Rich Recipes (C: Control, V-1: Variant-1, V-2: Variant-2)



CONCLUSION

All the food preparations developed by incorporating garden cress seeds were found to be organoleptically acceptable by the panel of judges. The study showed that no bitter after taste was sensed in variant-2 in all recipes in which processed garden cress was used whereas for variant-1 in all recipes had bitter after taste in which un-processed garden cress seed used. Among all recipes *ladoo* and *mathri* were liked higher while *shakkarpure* and biscuit were liked lesser by the panel of judges. On calculation basis, iron content 100 g *ladoo* and *mathri* was higher and percent increase highest at variant-2 in all developed recipes. The consumption of 100 g *ladoo* and *mathri* meted more than 75% iron RDA for adolescent girls Indian. Besides, this, consumption of these iron rich recipes can prevent or treat iron deficiency. Therefore, it can be very suitable recipes for enhancing the iron status of not only adolescent girls but also for all age groups. The vital part is through food supplementation, the developed best recipes viz. *ladoo* and *mathri* can be supplemented for anemic adolescents to combat anemia. Hence, it is concluded that these products could be recommended for supplementation in under nutrition intervention program for combating iron deficiency.

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