



# Nutritional Evaluation of Garden Cress Seeds (*Lepidium sativum*) Based Iron Enriched Recipes

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**Abstract:** Adolescence is a vulnerable period in human life cycle when nutritional requirements increases due to rapid growth spurt. More than 60 per cent of adolescent girls have been reported to be affected by iron deficiency anemia. Garden cress seeds (*Lepidium sativum*) are locally available inexpensive seeds which are excellent sources of iron, protein and  $\beta$ -carotene. The present study was planned to develop iron enriched four recipes viz. *ladoo*, *mathri*, *shakkarpore* and biscuits for adolescent girls using garden cress seeds 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 developed recipes were analysed for proximate composition, selected mineral content and *in-vitro* iron bioavailability. The variant-2 of *ladoo* and *mathri*, was higher in ash (2.10 and 2.27 %), crude fat (23.97 and 36.24 %), crude fibre (1.43 and 6.95 %) and crude protein (9.55 and 10.44 %). The selected mineral content was also higher in variant-2 of *ladoo* and *mathri*. Processing of seeds had significant effect on total iron, ionisable and soluble iron as well as per cent bioavailability of iron that enhanced after the treatment. Thus, among various developed recipes, variant-2 of, *ladoo* and *mathri* were highly nutritive.

**Keywords:** Garden cress, Proximate, Minerals, *in-vitro* iron bioavailability

Anemia is the most common nutritional deficiency disorder worldwide. 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 because, they are just on threshold of marriage and motherhood (Gwatkin et al 2003). Thus, nutritional pattern in these years has special significance. Garden cress (*Lepidium sativum*) is an annual herb, belonging to *Brassicaceae* family, which is native to Egypt and Asia (Malleshi and Guo 2004). In India, it is mainly cultivated in UP, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh (Kirtikar and Basu 2004). It is also cultivated in Himachal Pradesh but awareness regarding its health and nutritional benefits is very less and therefore the crop is mainly raised as fodder crop for animals. Garden cress helps to regulate menstrual cycle, increases milk production and secretion in lactating mothers and prevents post-partum complications. It is an effective medicine for general weakness in girls (Doke and Guha 2014). Garden cress seeds are therefore packed with the power of nutrients which can combat malnutrition, anemia and other micronutrient deficiencies. So, the idea of incorporating this crop (seeds) into sweet and salty food

preparations for supplementation also catches attention. Strategies for improving anemia include supplementation, fortification and improvement in the diet. But, there is an interest turning to approach of diet intervention that has higher potential for achieving far-reaching and long lasting benefits for the control of iron deficiency. 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. 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

Garden cress seeds were collected in bulk from local market and were processed. The whole garden cress seeds were sorted and cleaned to remove impurities and were ground in mixer and stored in airtight container. Treated 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 temperature of 60°C and kept for drying until they completely dried. Then they were ground in and the flour obtained was roasted and stored in airtight container. The

prepared samples were evaluated for various nutritional characteristics.

**Proximate analysis:** Protein, fat, fiber, ash, and moisture were determined and computed on dry weight basis according to AOAC (2010). The moisture content of samples was determined by drying the samples at 100°C until a constant weight was obtained. Dried samples were analysed to determine the total nitrogen content using microkjeldahl method. A conversion factor of 6.25 was used to calculate protein content. The ash content was determined by burning 1 g of oven-dried sample in a crucible in a muffle furnace at 550°C for 24 h. The total lipids were isolated using the Soxhlet method. Crude fiber was measured by digestion with 1.25% sulphuric acid followed 1.25% of sodium hydroxide, while the carbohydrates content was determined by the difference of total solid (100) minus other solid components.

**Minerals analysis:** The dried samples were wet digested in 25 ml of diacid mixture (nitric acid and perchloric acid; 9:4) as per method given by (Ranganna 2007). The digested samples were analyzed for sodium, potassium and calcium by using Flame Photometer Model Mediflame 128 and for

iron, zinc and copper atomic absorption spectrophotometer, AAS - 4129 was used. Phosphorus was determined by spectrophotometer. *In vitro* iron bio availability was also determined in samples (Rao and Prabhavati 1982). All the estimations were done in triplicate and reported on dry weight basis.

**Development of food products:** After trials of many recipes enrichment and prototype, 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. Variant-1 was subjected to incorporation of un-processed garden cress seeds. Variant-2 was subjected to incorporation of processed garden cress seeds. After a series of trials using ingredients in various proportions and adopting different processing methods, the concept of the iron enriched products took shape (Table 1). Garden cress seeds were chosen for iron enrichment along with other ingredients viz. amaranth seeds and sesame seeds to prepare *ladoo*, *mathri*, *shakkarpore* and biscuits and to find out the best iron rich recipe among

**Table 1.** Recipes standardized ingredients used

Control	Variant-1	Variant-2
<b>Ladoo</b>		
Amaranth flour-25g Wheatflour-25g Jaggery-40g Fat-10g	Amaranth flour-25g Wheat flour-20g Jaggery-40g Fat- 10g Garden cress flour (UP)-10g	Amaranth flour-10g Wheat flour-10g Jaggery-40g Fat- 10g Garden cress flour(P)-10g Sesame seeds-15g Grated coconut-5g Raisin-5g
<b>Mathri</b>		
Refined flour-25g Amaranth flour-30g Fat-20g	Refined flour-40g Amaranth flour-30g Garden cress flour(UP)-10g Fat-20g	Refined flour-50g Amaranth flour-20g Gardencress flour(P)-10g Sesame-16g Fenugreek-1g Fat -20g Black pepper-2g
<b>Shakkarpore</b>		
Refined flour-60g Sugar-30g Amaranth flour-10g	Refined flour-40g Amaranth flour-10 Garden cress flour(UP)-10g Sugar-30g	Refined flour-30g Amaranth flour-20g Garden cress flour(P)-10g Sugar-30g Sesame seeds-10g
<b>Biscuit</b>		
Refined flour-50g Amaranth flour-10g Fat-30g Salt-1g Sugar-4g Omum-2g Cumin-2g Baking powder-1pinch	Refined flour -45g Amaranth flour-5g Garden cress flour (UP)-10g Fat-30g Salt-1g Sugar-4g Omum-2g Cumin-2g Baking powder-1pinch	Refined flour -40g Amaranth flour-10g Garden cress flour (P)-10g Fat-30g Salt-1g Sugar-4g Omum-2g Cumin-2g Baking powder-1pinch

products viz. *ladoo*, *mathri*, *shakkarpare* and biscuits by nutritional quality.

#### Preparation method for recipes

**Ladoo-** Roasted wheat flour till light brown. Added all the measured ingredients in wheat flour and simultaneously prepared jaggery syrup of one thread consistency. Added

syrup in prepared mixer and made small rounded *laddoos*.

**Mathri-** In refined wheat flour, added all the measured ingredients and rubbed with melted ghee (shorting). Kneaded stiff dough and prepared small flattened rounded *mathri*, deep fried till light brown in colour.

**Shakkarpare-** Added all measured ingredients in refined wheat

**Table 2.** Proximate composition (% dry weight basis) developed recipes

Recipes	Proximate parameters	Treatments			
		Control	Variant-1	Variant-2	Mean
Ladoo	Moisture	8.08	8.68	7.93	8.23
	Ash	1.33	1.93	2.1	1.79
	Crude fat	23.71	23.87	23.97	23.85
	Crude fiber	0.36	1.1	1.43	0.96
	Crude protein	7.9	8.83	9.55	8.76
	Total carbohydrate	58.73	55.59	55.02	56.55
	Mean	16.69	16.57	16.82	16.69
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.04	0.02	0.07	
Mathri	Moisture	6.2	6.52	6.03	6.25
	Ash	1.47	1.9	2.27	1.88
	Crude fat	36.21	36.21	36.24	36.22
	Crude fiber	0.25	0.87	0.95	0.69
	Crude protein	8.45	9.97	10.44	9.62
	Total carbohydrate	47.42	44.55	44.07	45.35
	Mean	16.67	16.67	16.67	16.67
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.06	BS	0.11	
Sakkarpare	Moisture	5.7	6	5.58	5.76
	Ash	0.52	0.73	0.95	0.73
	Crude fat	31.8	31.95	32.15	31.97
	Crude fiber	0.08	0.72	0.8	0.53
	Crude protein	3.99	4.83	5.16	4.66
	Total carbohydrate	57.91	55.76	55.36	56.34
	Mean	16.67	16.67	16.67	16.67
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.09	BS	0.16	
Biscuits	Moisture	7.47	7.83	7	7.43
	Ash	1.02	1.8	2.23	1.68
	Crude fat	26.81	26.95	27.02	26.93
	Crude fiber	1.33	1.43	1.84	1.54
	Crude protein	6.09	6.47	6.82	6.46
	Total carbohydrate	57.51	55.51	55.09	56.03
	Mean	16.7	16.67	16.67	16.68
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.08	BS	0.14	

flour. Kneaded stiff dough and rested the dough for 20 min covered with damp cloth. Rolled it and cut into diamond shaped *shakkarpore*. Deep fried in medium flame till golden brown.

**Biscuits-** Mixed and sifted thrice all the measured ingredients. Creamed ghee and folded the flour into it. Prepared dough and rested for 20 minutes covered with

damp cloth. Rolled and cut in squares with the help of cutter and baked at 175 °C for 15 min.

## RESULTS AND DISCUSSION

**Proximate composition of developed recipe (% dry weight basis):** In *ladoo* all the proximate parameters like ash

**Table 3.** Mineral composition (mg100g<sup>-1</sup> DW basis) of developed recipes

Recipes	Minerals	Treatments			
		Control	Variant-1	Variant-2	Mean
Ladoo	Copper	5.54	6.19	7.08	6.27
	Zinc	3.45	4.06	6.77	4.76
	Calcium	38.01	42.02	51.32	43.78
	Sodium	8.00	11.21	17.00	12.07
	Phosphorus	125.30	139.70	146.21	137.07
	Potassium	441.61	633.11	692.12	588.95
	Mean	103.65	139.38	153.42	132.15
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.06	0.04	0.11	
Mathri	Copper	4.15	5.29	7.92	5.79
	Zinc	3.17	4.56	6.06	4.60
	Calcium	39.22	42.01	51.92	44.38
	Sodium	73.20	74.80	79.10	75.70
	Phosphorus	125.10	139.53	145.71	136.78
	Potassium	371.81	643.58	682.71	566.03
	Mean	102.78	151.63	162.24	138.88
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.35	0.25	0.062	
Shakkarpore	Copper	3.88	4.09	4.88	4.28
	Zinc	2.54	3.08	4.12	3.24
	Calcium	36.78	40.30	50.52	42.53
	Sodium	7.01	7.50	8.60	7.70
	Phosphorus	98.12	102.21	113.51	104.61
	Potassium	357.40	453.00	482.19	430.86
	Mean	84.29	101.70	110.64	98.87
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.33	0.23	0.58	
Biscuits	Copper	4.09	4.68	5.77	4.85
	Zinc	2.46	3.07	4.16	3.23
	Calcium	37.20	40.68	50.21	42.70
	Sodium	50.30	56.31	59.81	55.47
	Phosphorus	95.61	102.81	111.71	103.38
	Potassium	442.80	553.20	573.71	523.24
	Mean	105.41	126.79	134.23	122.14
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.09	0.06	0.15	

(2.10 %), crude fat (23.97 %), crude fibre (1.43 %), and crude protein (9.55 %) were significantly higher in variant-2 i.e. treated garden cress seeds incorporated *ladoo* except moisture (7.93 %) and carbohydrates (55.02 %). Similarly in *mathri*, variant-2 was analysed with high content of ash, crude fat, crude fiber (6.95 %) and crude protein. Similar trend was observed in variant -2 of *shakkarpore* and biscuits and having more amounts as compared to control and variant-1.

**Mineral content:** for proximate parameters, variant-2 of all the developed iron rich products was again assessed for its highest values of analysed minerals viz. copper, zinc, calcium, sodium and phosphorus when compared with variant-1 and control formulation. The mineral content of *ladoo* and *mathri* 7.08, 6.77, 51.32, 17.00, 146.21, 692.12

and 7.92, 6.06, 51.92, 79.10, 145.71, 682.71 mg 100g<sup>-1</sup> of copper, zinc, calcium, sodium, phosphorous and potassium were analysed on dry weight basis. Same trend was observed in *shakkarpore* and biscuits. The control provided 87.33 mg of calcium whereas the experimental samples provided more than 120 mg.

**In-vitro iron content:** Total iron content ranged between 32.92-69.71, 35.69-65.64, 34.95-49.32 and 37.73 -59.27mg 100g<sup>-1</sup> for *ladoo*, *mathri*, *Shakkarpore* and biscuits for different treatments. *In-vitro* iron content was significantly higher in variant-2 in all the recipes in which treated garden cress seed powder was used. It indicated that treated garden cress seed increased iron content in recipes. Four recipes, total iron content was reported highest in *mathri* 50.76 mg followed by *ladoo*5, biscuits mg and *shakkarpore* mg. *In-vitro*

**Table 4.** Total, ionisable, soluble iron content and bioavailability of iron content in whole and treated garden cress seeds

Recipes	Parameters	Treatments			
		Control	Variant-1	Variant-2	Mean
Ladoo	Total iron (mg100g <sup>-1</sup> )	32.92	47.92	69.71	50.18
	Ionisable iron (mg100 <sup>-1</sup> g)	1.83	2.44	3.55	2.61
	Soluble iron(mg100g <sup>-1</sup> )	25.53	39.76	55.93	40.41
	Bioavailable iron (%)	2.88	2.92	3.07	2.96
	Mean	15.79	23.26	33.07	24.04
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.02	0.02	0.04	
Mathri	Total iron (mg100g <sup>-1</sup> )	35.69	50.94	65.64	50.76
	Ionisable iron (mg100g <sup>-1</sup> )	1.85	2.81	3.63	2.76
	Soluble iron(mg100g <sup>-1</sup> )	25.72	40.07	58.45	41.41
	Bioavailable iron (%)	2.17	2.93	3.06	2.72
	Mean	16.36	24.19	32.70	24.41
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.02	0.02	0.04	
Shakkarpore	Total iron (mg100g <sup>-1</sup> )	34.95	36.22	49.32	40.16
	Ionisable iron (mg100g <sup>-1</sup> )	0.85	1.15	1.53	1.18
	Soluble iron(mg100g <sup>-1</sup> )	26.12	30.05	38.80	31.66
	Bioavailable iron (%)	1.98	2.04	2.45	2.16
	Mean	12.78	13.90	18.43	15.04
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.02	0.02	0.03	
Biscuits	Total iron (mg100g <sup>-1</sup> )	37.73	42.21	59.27	46.40
	Ionisable iron (mg100g <sup>-1</sup> )	1.22	1.73	1.94	1.63
	Soluble iron(mg100g <sup>-1</sup> )	27.75	36.95	43.63	36.11
	Bioavailable iron (%)	1.64	1.90	1.99	1.84
	Mean	17.09	20.70	26.71	21.50
	Factors	Parameters (A)	Variant (B)	A×B	
	CD (p=0.05)	0.02	0.02	0.04	

iron content (ionisable iron, soluble iron and per cent bioavailability iron) was highest in *ladoo* (3.55 mg, 55.93 mg and 3.07 %) and *mathri* (3.63 mg, 58.45 mg and 3.06 %). The treatment of soaking and drying of garden cress seeds had an appreciable influence on total iron, ionisable iron and soluble iron content as well as bioavailability of iron in variant-2 for all developed recipes when compared with variant-1 having incorporation of unprocessed garden cress seeds and control which contained no garden cress. Singh and Srivastava (2012) also observed same trend in iron rich *namakpare* mixes. Nathiya and Viganini (2014) formulated and assessed the nutrient content of cookies (nutricookies) and observed that samples with 10g, 20g and 30g garden cress seeds provided 24.58, 34.58 and 44.58 mg of iron 100g<sup>-1</sup>.

Rana and Kaur (2016) prepared supplemented products viz. biscuits, *ladoo* and *namakpare* with garden cress seeds using proportions of 5, 10 and 15 per cent. The iron content of supplemented biscuit was 13.60 mg and that of control was 5.20 mg. The iron content of control *ladoo* was 6.49 mg which significantly increased in supplemented *ladoo* to 13.37 mg. The iron content of control *namakpara* was 2.70 mg which increased to 7.61 mg in supplemented *namakpara*. Kaur et al (2018) reported that in vitro iron bioaccessibility of legumes based product reported maximum when fortified with ascorbic acid rich foods.

### CONCLUSION

Present investigation reveals the effect of garden cress seeds on nutritional quality of *ladoo*, *mathri*, *shakkarpare* and biscuits. Garden cress is rich source of iron. Processing i.e. soaking for 3 hrs, drying at 60°C and roasting of seeds had significant effect on proximate composition, minerals content, total iron, ionisable and soluble iron as well as per

cent bioavailability of iron that enhanced after the treatment. These iron rich recipes can be recommended for supplementation in nutrition intervention program for combating iron deficiency.

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