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Nutritional and anti nutritional analysis of iron rich flour develop by using of garden cress seeds

Khushbu Gurjar and Renu Mogra

Garden cress (*Lepidium sativum* Linn.) is an annual herb, belonging to Brassicaceae family. Today, garden cress seed used as a good source of iron to prevent anemia. The present study was conducted to develop iron rich flour incorporated with garden cress seeds and assess its nutritional and anti-nutritional composition. Two combination of iron rich flour were developed *viz*., 90:10 per cent in (Wheat flour + garden cress seed flour) and 60:15:15:10 per cent in (Wheat flour + pearl millet flour + rice flour + garden cress seed flour) flours, respectively to prepare 100 g of flour mix. Nutritional composition of flours revealed that control (wheat flour) contained 11.54 g/100g moisture, 12.03g/100g protein, 1.76 g/100g fat, 71.62 g/100g carbohydrate,1.83 g/100g crude fibre and 350.24 kcal per 100 g . WG flour contained 10.89 g/100g moisture, 13.30g/100g protein, 3.50 g/100g fat, 67.41 g/100g carbohydrate, 2.34 g/100g crude fibre and 354.33/100g kcal and nutritional composition revealed that WPRG flour contained 11.15 g/100g moisture, 13.30 g/100g protein, 3.36 g/100g fat, 67.88 g/100g carbohydrate, 2.8 g/100g crude fibre and 350.36 kcal/100g. Phytic acid contents of flours were found 1.35, 7.38 and 7.53 mg/100g. It can be inferred from the above results that the iron rich flour mix were nutritious, acceptable and safe for human consumption.

Key Words : Garden cress seed, Anemia, Nutritional, Anti- nutritional, Phytic acid

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INTRODUCTION

Iron is necessary for synthesis of hemoglobin. Iron deficiency is thought to be the most common cause of anaemia globally (NHRM, 2014). Iron deficiency disorder affect 1.6 billion people in the development world (WHO, 1993-2005). According to World Health Organization, (2008) global estimate of prevalence of anaemia was (56%) with a range of (35- 75%) depending on geographic location. Prevalence of anaemia in South Asia is highest in the world, mirroring overall high rates of malnutrition. Findings of the National Family Health Survey-3 revealed that 53.1 per cent of women aged 15 to 49 years are anaemic in Rajasthan. Besides, moderate anaemia increases the risk of maternal death by 1.35 times and severe anaemia by 3.5 times.Throughout human history, plants have played a key role in treating human diseases. In thousands of years of trials many plants have been identified, which are good for treating ailments and curing serious health problems like cancer, diabetes and atherosclerosis etc. (Rana *et al.*,2011). Certain leafy vegetables like leaves of garden cress, amaranth, betal, cauliflower greens, cow pea and oilseeds like garden cress, rajkeera are rich plant source of iron (Khimiji and

MEMBERS OF RESEARCH FORUM

Author for correspondence :
Khushbu Gurjar, Department of Food Science and Nutrition, College of Community and Applied Sciences, Maharana Pratap University of Agriculture and Technology, **Udaipur (Rajasthan) India**

Associate Authors' :
Renu Mogra, Department of Food Science and Nutrition, College of Community and Applied Sciences, Maharana Pratap University of Agriculture and Technology, **Udaipur (Rajasthan) India**

Capadia, 2012).

Garden cress (*Lepidium sativum* Linn.) is an annual herb, belonging to Brassicaceae family. Ethiopia is the origin of this seed. About 150 species are found in the temperate and sub temperate area. It can grow in any climate and soil condition. The climatic condition of India is much favourable for the cultivation (Wadhawa *et al*., 2012). In India, it is mainly cultivated in UP, Rajasthan, Gujarat, Maharashtra and Madhya Pradesh (Agarwal and Sharma, 2013).

Garden cress seeds are the richest source of iron (1mg/1g). So even if we consume 1tbsp of this seed daily we can be close to our recommended intake of iron. Seed or seed powders can be sprinkled over cereals, mixed with fresh green vegetables, yoghurt or added to snacks. Seeds could be sprouted and consumed as salads or vegetables. Added to wraps, sandwiches or stir-fries as well (Seeds: Nutrient packed germs of life, *www. medindia.net/patients/lifestyleandwellness*).

Prevalence of anaemia among adolescent girls in urban slum was studied by (Kulkarni, 2012) among 272 adolescent girls of urban slum area and reported that prevalence of anaemia was found to be very high (90.1%) among adolescent girls with majority of the girls having mild or moderate anaemia (88.6%). Amawi and Aljamal (2012) studied the effect of Gc seed aqueous extract on lipid profiles and blood glucose levels of hypercholesterolemic and alloxan induced diabetic albino rats. Gc seed extract (20mg/kg) was orally administered for four weeks to hypercholesterolemic and diabetic rats and they reported lower lipid profile and reduction in blood glucose level in both the cases. Mahassni and Al-Reemi (2013) investigated the cytotoxic effect of Gc seed aqueous extract on human breast cancer cells using human breast cancer cell line MCF-7 (Michigan Cancer Foundation–7).

Toxicity test showed that the administration of ehanolic extract of *Lepidium sativum* in single doses of 0.5 to 3.0 g/kg did not produce any adverse effects or mortality in mice, whereas the animals treated with similar extract (100mg/kg/day) for a period of three months in drinking water showed no symptoms of toxicity except statistically insignificant higher mortality rate in mice (Sarkar *et al.*, 2012).Cereals and millets are the primary sources of minerals in most vegetarian diets, secondary sources being legumes. Besides inherent factors such as phytate, tannin and fibre negatively influencing the bioavailability of zinc and iron from these food grains, the same may also be influenced by processing, such as cooking, boiling, roasting or germination which these food grains undergo. Food processing by heat generally alters the bioavailability of nutrients –both macro and micro (Amparo, 2003). Due to high levels of calcium, iron, zinc, lipids and high quality proteins, pearl millet is comparable and even superior to major cereals with respect of energy value, proteins, fat and minerals. Pearl millet contains the highest amount of iron among all the cereals; it is also rich source of calcium and dietary fibre, phytochemical and micronutrients. It makes an important contribution to human diet; it is also a rich source of dietary fibre and micro nutrients (Sehgal, 2006 and Malik, 2002).

Supplementary foods like iron rich biscuit were developed using locally available iron rich food stuffs *i.e.* garden cress seeds and rice flakes (Zanvar and Devi, 2007).

Objective of the study:

– To develop iron rich flours using garden cress seeds.

– To assess nutritional and anti nutritional analysis of developed flours.

METHODOLOGY

The present study was conducted in Department of Food and Nutrition, College of Home Science, Maharana Pratap University of Agriculture and Technology Udaipur (Rajasthan).

Development of iron rich flour :

Two different combinations of flour *viz.*, Wheat + garden cress seeds, Wheat + pearl millet + rice flakes + garden cress seed were developed. To develop iron rich flour wheat, pearl millet, rice flakes and garden cress seeds were cleaned and milled separately.

Flours (wheat, pearl millet, rice flakes and garden cress seed) were mixed in different ratios for the development of two different combinations of iron rich flours. In first combination of iron rich flour, wheat flour and garden cress seed flour were mixed at ratio *viz.*, 90:10 per cent, respectively. Second combination was obtained by mixing of wheat flour, pearl millet flour, rice flakes flour and garden cress seed flour at ratio *viz.*,

60:15:15:10 per cent, respectively.

Proximate composition, iron content, bioavailability of iron:

Proximate composition is the determination of closely related compounds together. It includes determination of amount of moisture, protein, fat (ether extract) and fibre with nitrogen free extract and carbohydrate, subtracting the sum of these five percentages from 100.

Moisture:

Moisture content of samples was analyzed by the method described by NIN (2003).

$$\text{Moisture (g/100g)} = \frac{\text{Initial weight (g) - Final weight (g)}}{\text{Weight of the sample (g)}} \text{x100}$$

Crude protein:

The protein content of food stuff is obtained by estimating the nitrogen content of the material and multiplying the nitrogen content by the factor 6.25 (NIN, 2003).

$$\text{Nitrogen (g/100g)} = \frac{\text{(ml HCL in determination - ml blank)x normality of HCL x14x100}}{\text{Weight of the sample (mg)}}$$

The protein content of the sample was obtained by multiplying the nitrogen with a factor 6.25.

Crude fat:

Fat was estimated as crude ether of moisture free sample by the method given by NIN (2003). The amount of fat present in the sample was calculated using the following formula:

$$\text{Fat (g/100g)} = \frac{W_2 - W_1}{W}$$

where,

W = Weight of sample (g)

W_1 = Weight of empty beaker (g)

W_2 = Weight of beaker + fat (g).

Ash:

Ash was estimated by the method given by NIN (2003). Ash content of sample was calculated using following formula:

$$\text{Ash (g/100g)} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample taken (g)}} \text{x 100}$$

Crude fibre:

Crude fibre estimation was done as per the method given by NIN (2003). Crude fibre was determined by using following formula:

$$\text{Per cent crude fibre (g/100g)} = \frac{(W_2 - W_1) - (W_3 - W_1)}{\text{Weight of sample (g)}} \text{x 100}$$

Carbohydrate:

The carbohydrate content of the sample on dry weight basis was calculated by difference method Gopalan *et al.*(1989) as given below:

Carbohydrate (g/100g) = 100- (moisture + crude fibre + ash + protein + fat)

Energy:

The energy value of sample was calculated using physiological fuel value *i.e.* 4, 9, 4 kcal per g of protein, fat and carbohydrate, respectively.

Energy (kcal/100g) = [(% protein × 4) + (% carbohydrate ×4) + (%fat× 9)]

Iron content:

Mineral solutions of selected samples were prepared by wet ashing method compiled by Jain and Mogra, (2006). The plant material was digested with a mixture of acids to from a clear white precipitate which was then dissolved in water and made upto a definite volume. An aliquot from this was used for determination of selected minerals.

Iron:

It was analyzed by using Atomic Absorption Spectrophotometer (Bishnoi and Brar,1988).

Estimation of iron bioavailability:

Bioavailability of iron was estimated by the method compiled by Jain and Mogra (2006).The iron content of the samples was estimated from the standard graph and expresses in mg per 100 g.

The extractability was determined as given below:

$$\text{Extractability (\%)} = \frac{\text{HCL extractability (ml) x 100}}{\text{Total mineral (ml)}}$$

Anti nutritional factor:

Phytate:

Phytic acid content of the sample was estimated using the method complied by Jain and Mogra (2006).

$$\text{Phytin phosphorus (g/100g)} = \frac{\text{Weight of dried precipitate}}{\text{Weight of sample}} \times 100$$

OBSERVATIONS AND ASSESSMENT

Results obtained during the course of investigation were subjected to suitable statistical analysis, tabulated and systematically presented through classified and supportive material enabling investigation to interpret the comprehensive outcomes.

Wheat, pearl millet grain, rice flakes and garden cress seeds were procured in single lot from the local market of, Udaipur. To develop iron rich flour; wheat, pearl millet, rice flakes and garden cress seeds were cleaned to remove dirt, stones and inedible materials.

– Wheat, pearl millet, rice flakes and garden cress seeds were milled.

– Flours were mixed in different ratios and standardised.

Flours (wheat, pearl millet, rice flakes and garden cress seed) were mixed in different ratios for the development of two different combinations of iron rich flours. The first combination (wheat + garden cress seed) of flour was mixed in ratio *viz.*, 90:10 and second combination (wheat + pearl millet + rice flakes + garden cress seed), flours were mixed in different ratios *viz.*, 60:15:15:10 per cent, respectively to prepare 100 g of flour mix each . Two combination (Table 1) were prepared.

Proximate composition:

Proximate composition of iron rich flours has been presented in Table 2 (Fig. 1 and 2).

Mohite *et al.* (2012) reported that garden cress seeds have health promoting properties s it contains 25-39 per cent of protein. Thirty three per cent carbohydrate, 2.4 per cent crude fat, 7.6 per cent crude fibre and 6.4 per cent minerals. The garden cress seeds are a rich source of omega 3 fatty acids which helps to lower cholesterol in hyper cholesterolemic patients.

Mohammed (2012), reported that the garden cress seeds contain 25 per cent of protein, 14 24 per cent of lipids, 33 54 per cent of carbohydrates and 8 per cent of crude fibre. The carbohydrates of the garden cress seeds comprise of 90.0 per cent non- starch polysaccharides and 10 per cent of starch. The seed bran has high dietary fibre content and also it has high water holding capacity. Garden cress bran can be used as a rich source of dietary fibre. Garden cress seed contains the major fatty acid alpha linolenic acid (32 34%). The moisture content of seed flour was reported to be 5.29 ± 1.30%. This low level of moisture content is an index of stability, quality and increased shelf-life of seeds.

Moisture content of iron rich flours ranged from 10.89 to 11.54 g per 100 g with the maximum value for wheat flour (control, 11.54g/100 g) and minimum value for wheat flour + garden cress seed flour was 10.89 g/ 100 g. A significant difference ($p < 0.05$) was observed between moisture content of all flours. A glance of Table 2 illustrates that the fat content of control, wheat flour + garden cress seed flour and wheat flour + pearl millet flour + rice flake flour + garden cress seed flour was 1.7, 3.5 and 3.3g per

Table 1: Preparation of different combination of iron rich flour

Sr. No.	Combinations	Ratio	
1.	WG (Wheat + garden cress seed)	R_1	90:10
2.	WPRG (Wheat + pearl millet + rice flakes + garden cress seed)	R_2	60:15:15:10

Table 2 : Proximate composition of iron rich flours (Mean ± SD values)

Flours	Moisture (g/100g)	Protein (g/100g)	Fat (g/100g)	Carbohydrate (g/100g)	Energy (kcal)	Crude fibre (g/100g)
C	11.54±0.44	12.03±0.68	1.76±0.25	71.62±0.79	350.24±0.82	1.83±0.20
WGF	10.89±0.52	13.30±0.42	3.50±0.30	67.41±1.46	354.33±4.65	2.34±0.06
WPRGF	11.15±0.14	22.50±0.52	3.36±0.25	67.88±0.40	350.36±2.52	2.8±0.01
GM	11.19	15.94±4.97	2.87±0.86	68.97±2.17	351.64±3.35	2.32±0.43
SE	0.2348	0.3201	0.1552	0.5707	1.7877	0.0800
C.D. (P=0.05)	0.81NS	1.10	0.5369	1.9749	6.1867 NS	0.2769
CV	3.63	3.48	9.34	1.43	0.88	5.96

C= Control, WGF= Wheat flour + garden cress seed flour, WPRGF= Wheat flour + pearl millet flour + rice flake flour + garden cress seed flour,
NS = Not-significant All the values are average of the three observations, Values are calculated on dry weight basis.

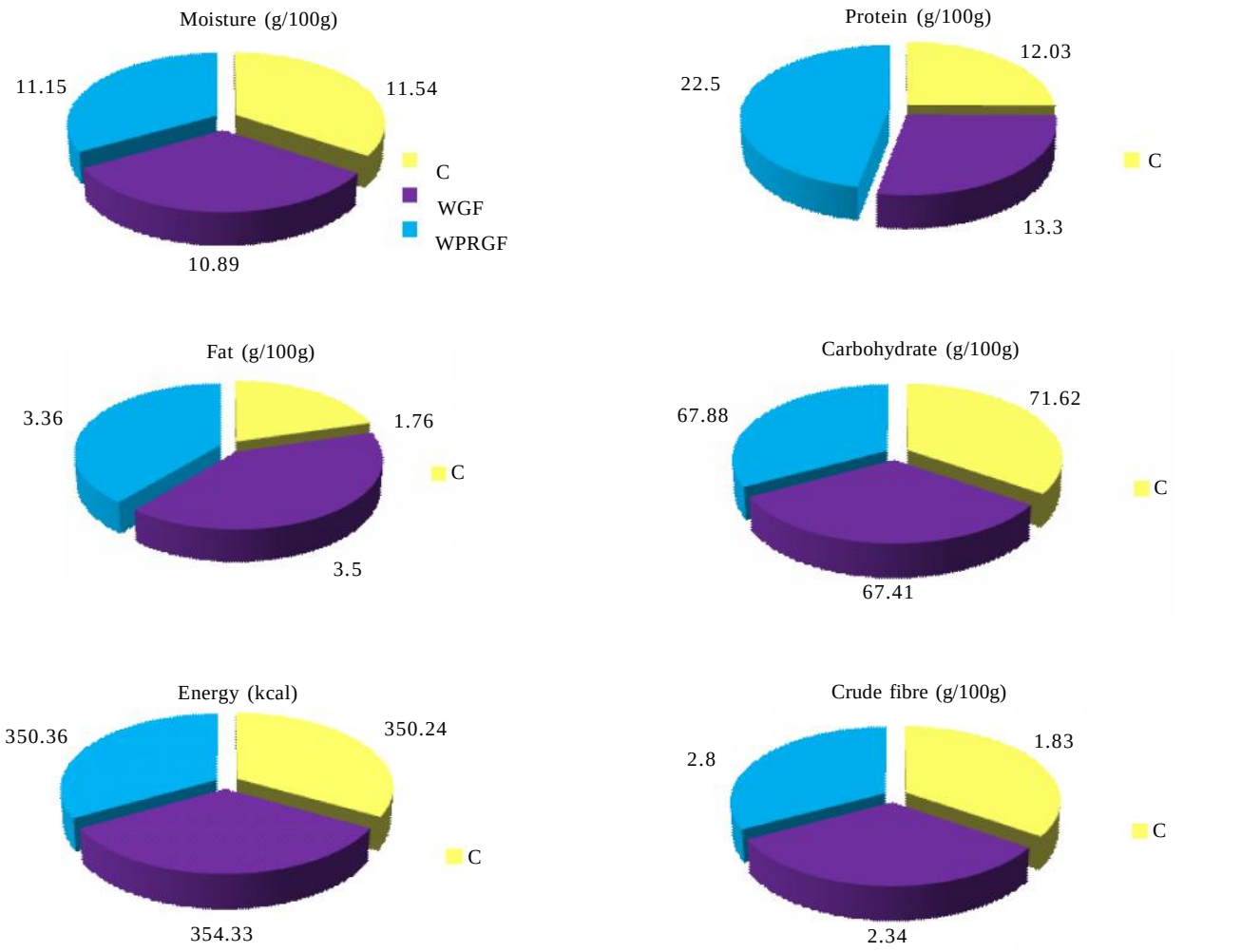

Fig. 1 : Proximate composition of iron rich flours

100g, respectively. Here, a lower value of fat (1.7g) was found in wheat flour (control). Protein content was found to higher in wheat flour + pearl millet flour + rice flake flour + garden cress seed flour (WPRGF, 22.50g per 100 g) followed by wheat flour (control, 12.03g) and wheat flour + garden cress seed flour (WGF, 13.30g). Data on ash content of the flours revealed that the highest value was found in flour + garden cress seed flour (WGF, 2.68g) followed by wheat flour + pearl millet flour + rice flake flour + garden cress seed flour (WPRGF, 2.46g) and control (1.20). Fibre content of WPRGF and WGF was 2.80 and 2.34g per 100g, respectively. Zanvar and Devi (2007) reported that supplementary foods like iron rich *Biscuit* were developed using locally available iron rich food stuffs *i.e.* garden cress seeds and rice flakes which contained 29.61 g of fat, 0.99 g fibre, 2.8 g protein.

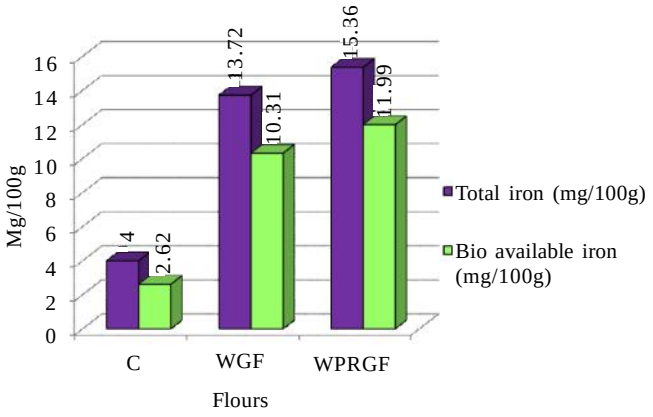

Fig. 2 : Total iron and bioavailability of iron of iron rich flours

Agarwal (2011) stated that garden cress seed contains high amount of protein and iron. It has also been said to have significant amount of calcium and folic acid in

addition to vitamin A and C. Food products (*Ladoo* and *Baaal ahar*) developed by using of garden cress seeds was nutritionally analyzed and found 25.3 per cent protein content along with content of iron at around 100mg/100g.

Agarwal and Sharma (2013) stated that the mean protein content of garden cress seed flour (whole garden cress seed flour) was 25.09±0.51 g/100g. Mean scores of fat content for garden cress seed flour was 21.83 ±0.28g/100g, the mean fibre contents was 7.86±0.05. Calculated value for the carbohydrate content of sample (Table 2) were 71.62, 67.41 and 67.88g per 100g in control flour, WGF and WPRGF, respectively. The carbohydrate content of WG flour was lowest. The values were 350.24 kcal in wheat flour, 354.33 kcal in WG flour and 351.64 kcal in WPRG flour per 100g. No significant difference was found in energy (kcal) of all flours.

Iron content:

Total iron and bio available iron content of iron rich flour has been presented in Table 2 and Fig. 2

The results revealed that the iron content of iron rich flour ranged from 4.0 to 15.36 mg per 100 g with the maximum value for total iron in wheat flour + pearl millet flour + rice flake flour + garden cress seed flour (15.36 mg per 100 g) and minimum value for control (4.0 mg per 100 g). Gaafar *et al*. (2010), reported that 377 mg calcium, 723 mg phosphorus and 100 mg per 100 g of iron in *Lapidium sativum*.

Bio availability of iron:

The bio availability of iron content in iron rich flours ranged from 2.62 to 12.99 mg per 100 g (Table 2 and Fig. 2). Maximum value of bio availability of iron in wheat flour + pearl millet flour + rice flake flour + garden cress seed flour (11.99 mg per 100 g) while the minimum availability of iron was found in control (1.62 mg per 100 g). There was significant difference ($p < 0.05$) in flours.

Sarkar *et al*. (2014) reported that garden cress seed is the highest iron containing plant source ever known with better bioavailability.

Conclusion :

Nutrient composition of 100 g flours revealed that the flours contained 10.89 to 11.54 g moisture, 12.03 to 22.50 g protein, 1.76 to 3.50 g fat, 1.20 to 2.68 g ash, 1.83 to 2.80 g fibre, 67.41 to 71.62 carbohydrate and energy 35o.24 to 354.33 kcal. Iron content of flours was found 4.0 to 15.36 mg/100g. Bio availability of iron was found 0.72 to 2.99 mg/100g in flours.

Thus, it can be concluded that the iron rich flours were nutritious and content high amount of iron. Anemic subjects may be advised to include garden cress seed mix flour in their daily diet.

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