



Research Article

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Nutritional Evaluation of Garden Cress Chikki



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Abstract

Background: Chikki is a popular traditional sweet snack of India. It can be made nutrient dense with the supplementation of garden cress seeds which contain a remarkable percent of protein, fat, energy, minerals and vitamins. The present study aimed to perform nutritional evaluation of the nutrient rich garden cress chikki.

Materials and methods: Roasted garden cress seeds were supplemented in chikki at the level of 25 percent to make it nutrient dense and nutritional evaluation of control and supplemented chikki was performed to analyze their proximate composition, amino acids, fatty acid composition, minerals, in-vitro starch and protein digestibility and anti nutritional factors.

Results and discussion: The supplemented chikki contained significantly ($p \leq 0.01$) higher percentage of protein (14.47%), fat (21%), ash (4.5%), fibre (2.90%) and energy (482 Kcal/ 100 g) than control chikki. amino acids content and fatty acid composition were also found to be increased in garden cress chikki as compared to control chikki. It also provided significantly ($p \leq 0.01$) improved amount of calcium (163.57 mg/100g), iron (9.92 mg/100g), and zinc (2.24mg /100 g) with increased per cent ionizable iron (11.97%) and its per cent bioavailability (6.11 %). The supplemented chikki was found with increased oxalates (73.88mg/100g) and phytin phosphorus content (286.1 mg / 100 g) which decreased the in vitro digestibility of starch (57.92 %) and protein (82.27 %) in supplemented chikki.

Conclusion: Roasted garden cress seeds supplemented chikki was found richer in proximate, amino acids and fatty acid composition than control chikki which has potential to be fed to poor and malnourished children through various supplementary feeding programmers.

Keywords: Chikki; Garden cress; Nutritional evaluation; Traditional snack

Introduction

Chikki is a popular traditional sweet snack of India which is liked and consumed by all the sections of population. It is formulated with roasted peanuts and jaggery syrup which provides calories, protein and other nutrients. The nutritional value of Chikki can be enhanced with the supplementation of garden cress seeds. Garden cress (*Lepidium sativum*, family-Cruciferae) has been considered as an important nutritional and medicinal plant in India since Vedic era due to its health promoting properties. The seeds contain 25.3 per cent protein 24.5 per cent fat and provide 454 Kcal/100g. It is a good source of calcium (377mg/100g), iron (100mg/100g), magnesium (430mg/100g) and other nutrients (thiamine, 0.59mg/100g; riboflavin, 0.61mg/100g; niacin, 14.3mg/100g) Gopalan et al. [1]. It also acts as memory boosters as it contains essential fatty acids like arachidic and linoleic acid. It is commonly known as "common cress", "land cress", "Haliv", "Asalio" or "Chandrasur" in India Gokavi et al. [2]. It is specifically a winter crop but grown in all seasons in every parts of India.

So an attempt has been made to develop nutrient rich garden cress chikki and analyze its nutrient composition over control chikki. Being cost effective, it may help to improve nutritional status and reduce malnutrition.

Material and methods

Procurement or garden cress seeds

Garden cress seeds, used for the preparation of food products, were purchased from local market. The seeds were roasted (at 150°C approximately for 3-5 minutes) in an iron vessel till a prominent aroma of garden cress seeds comes. After cooling, the seeds were packed in air tight plastic container and stored at ambient conditions (20°C, 60 % RH).

Preparation of chikki

Preparation of chikki was done in the Food Laboratory of Food and Nutrition Department, College of Home Science, PAU, Ludhiana. Chikki were developed by using the following

formulations: Jaggery (80g) was crushed and made into syrup with addition of water (40ml) by heating it till the temperature reached 145°C and immediately roasted peanut halves was added after turning off the flame and mixed thoroughly till peanuts get coated with jaggery syrup. The mixture was poured on a pre greased surface and spread uniformly with the help of roller, cut into square pieces and kept for cooling at room temperature [3].

Garden cress chikki was developed by supplementing 25 percent of roasted garden cress seeds which was found organoleptically acceptable among all treatment (15,20,25% level of supplementation) on the 9 point hedonic scale [4] by the panel of 10 judges who were familiar with the major sensory attributes of food products.

Nutritional Analysis

Proximate composition

Proximate composition was analyzed by standard methods [5].

Amino acid analysis: Extraction of sulphur amino acids was done by hydrolysing the samples in autoclave for 6 hours at 15 lb pressure. After filtration, hydrolyzed samples were used for the determination of methionine [6] and cystine [7]. Lysine was assessed by method of Carpenter, 1960 modified by Booth, 1971 and estimation of tryptophan was done by Concon [8].

Estimation of fatty acid composition

Oil was extracted from raw and processed garden cress powder through soxhlet extraction method and extracted oil samples were analyzed for fatty acid composition by gas chromatography using fatty acid methyl esters (FAME) preparation [9]. FAMES were analyzed on a gas chromatograph (Varian CP 3800, USA), equipped with a flame ionization detector (FID) and a fused silica capillary column (50m × 0.25 mm i.d.), coated with CP-SIL 88 as the stationary phase. The oven temperature was set at 200°C for 13 min. The injector and FID were at 250°C. A reference standard FAME mix (Supelco Inc.) was analysed under the same operating conditions to determine the peak identity. The samples were analysed for saturated fatty acids (C 16:0 and C 18:0), mono unsaturated fatty acids (C 18:1 and C 20:1) and poly unsaturated fatty acids (C 18:2 and C 18:3). The FAMES were expressed as relative area percentage.

Total minerals

For minerals, the samples were wet digested in hot plate using nitric acid and perchloric acid mixture in 5:1 ratio (v/v) and used for the determination of total amount of calcium, iron and zinc by atomic absorption spectrophotometry [10].

Percent ionizable iron and percent iron bioavailability: In vitro iron was performed by following [11] method and

percent bioavailability was estimated by using the following equation defined by Rao & prabhawati [11].

$$Y=0.4827+0.4707X$$

$$X = \frac{\text{Ionizable iron}}{\text{Total iron}} \times 100$$

where, Y=% iron absorption in adult

X=ionizable iron at pH 7.5

In vitro starch, protein and iron: In vitro digestibility of carbohydrate was performed by estimating the quantity of maltose released from samples by employing dinitrosalicylic acid method of Bernfeld [12]. For digestion of starch, pancreatic alpha amylase was used and samples were incubated at 37°C for two hours. Amount of released maltose was expressed in percentage. In vitro protein digestibility was assessed by Akesson & stachman [13] method. The samples were digested with pepsin solution followed by pancreatin solution and incubated at 37°C for 24 hours. The amount of nitrogen from the digested samples was calculated by subtracting residual protein from total protein of the sample and expressed in percentage.

$$\text{Protein digestibility(\%)} = \frac{(\text{Total Protein} - \text{residual protein})}{\text{Total Protein}} \times 100$$

Antinutritional factors

Oxalic acid was determined by titring oxalates containing sulphuric acid against potassium permanganate as described by Abeza et al. [14] and extraction of phytic acid was done by employing hydrochloric acid and keeping the solution for 3 hours. Amount of phytin phosphorus was measured by using 2, 2 bipyridine solution on spectrophotometer [15].

Statistical analysis

The values were taken in triplicate and data were subjected to statistical analysis using Statistical Package for Social Sciences (SPSS) version 16.0. t test was used to obtain the differences between control and garden cress seeds supplemented chikki. Level of significance was accepted at p< 0.05.

Nutritional evaluation

Table 1: Proximate composition of control and garden cress chikki.

Proximate Composition (%)	Control	Acceptable	T Test
Protein	13.83±0.08	14.47±0.35	3.87**
Fat	20.24±0.15	21.00±0.15	11.83**
Fiber	2.22±0.15	2.90±0.10	7.9**
Ash	4.1±0.1	4.5±0.1	5.94*
Cardohydrate	59.61	57.13	-
Energy (Kcal)	471.57	482.03	-

$$\# \text{Carbohydrate} = 100 - (\text{Protein} + \text{Fat} + \text{Fiber} + \text{Ash})$$

$$@ \text{Energy} = (\text{Protein} \times 4) + (\text{Carbohydrate} \times 4) + (\text{Fat} \times 9)$$

Acceptable level of garden cress supplementation at 25%

Values are mean \pm SD

*Significant at 5% level

**Significant at 1% level.

Proximate composition: The perusal of the Table 1 showed the proximate composition of control and supplemented chicki. The protein content of chicki was analyzed as 13.83 \pm 0.08 per cent in control chicki which was higher by 4.47 per cent in supplemented chicki (14 \pm 0.17 %) with significant difference ($p \leq 0.01$). The fat content of supplemented chicki (21.46 \pm 0.15 %) was significantly ($p \leq 0.01$) increased (5.72 %) with supplementation of garden cress seeds as compared

to control (20.24 \pm 0.15 %). Similarly, fibre content also found to be increased significantly in supplemented chicki (2.90 \pm 0.10 %). The ash content of control chicki was found to be 4.1 \pm 0.10 per cent which increased (9.76 %) significantly to 4.5 \pm 0.10 per cent in supplemented chicki. The available carbohydrate and energy content of control and supplemented chicki was calculated as 59.61 and 57.13 per cent and 471.57 and 482.03 Kcal respectively. Chahal & Sehgal [16] and Byrappa et al. [17] prepared chicki using till and ground nut and soy protein isolate, which supports the results of present study.

Amino acids

Table 2: Amino acid and fatty acid composition of control and garden cress chicki

Amino Acids (g/100g of protein)	Control	Acceptable	t test
Methionine	0.93 \pm 0.03	0.95 \pm 0.05	0.62*
Lysine	3.58 \pm 0.03	4.01 \pm 0.06	4.2**
Tryptophan	0.93 \pm 0.08	1.11 \pm 0.07	1.96
Cystine	1.19 \pm 0.04	1.13 \pm 0.02	1.21
Fatty Acid Composition (%)			
Palmitic acid (16:0)	12.63 \pm 2.20	12.33 \pm 2.00	0.87
Stearic acid (18:0)	2.87 \pm 0.15	2.90 \pm 0.20	0.91
Oleic acid (18:1)	41.20 \pm 2.08	41.83 \pm 1.35	1.08
Linoleic acid (18:2)	34.03 \pm 0.21	34.07 \pm 0.23	0.88
Linolenic acid (18:3)	0.60 \pm 0.10	1.20 \pm 0.10	8.82**
Ecosanoic acid (20:1)	1.63 \pm 0.05	1.62 \pm 0.06	0.74

Acceptable level of garden cress supplementation at 25%

Values are mean \pm SD

*Significant at 5% level

**Significant at 1% level.

Amino acid content of chicki has been tabulated in the Table 2. The lysine content of supplemented chicki (4.01 \pm 0.06g/100g protein) was found to be significantly ($p \leq 0.01$) increased by 12.0 per cent as compared to control (3.58 \pm 0.03 g per 100 g protein). Peanuts have less lysine (3.58g /100 g protein) content, which was replaced by roasted garden cress seeds which has more lysine (5.90g /100 gprotein) [1,18]. The methionine content of supplemented chicki (0.95 \pm 0.05 g /100 g protein) was found to be increased than that of control (0.93 \pm 0.03g /100 g protein) due to garden cress supplementation which has more methionine content (0.97g/100g protein) than peanuts (0.93 g /100 g protein). The cystine content for control was analyzed as 1.19 \pm 0.04 g per 100 g protein while for supplemented chicki it was observed to be 1.13 \pm 0.02 per 100 g protein. The tryptophan content for control and supplemented chicki was found to be 0.93 \pm 0.08 and 1.01 \pm 0.07 g per 100 g protein (Table 2). Garden cress seeds have good amount of lysine and fair amount of tryptophan but limited in methionine and cystine content. Thus value of methionine was decreased in supplemented chicki.

Fatty acid composition

Chikki showed 12.63 \pm 2.20, 41.2 \pm 2.08, 34.03 \pm 0.21 per cent palmitic, oleic and linoleic acid (Table 2). But supplemented chicki showed a little decrease in palmitic (12.33 \pm 2.0 %) and a little increase in oleic (41.83 \pm 1.35 %) and linoleic acid content (34.07 \pm 0.23 %). Linolenic acid increased significantly ($p \leq 0.01$) from 0.60 \pm 0.10 per cent to 1.20 \pm 0.10 per cent in supplemented chicki. Almost negligible difference was found in stearic (2.87 \pm 0.15 and 2.90 \pm 0.20 % in control and supplemented chicki) and ecosanoic acid content (1.63 \pm 0.05 % and 1.62 \pm 0.06 % in control and supplemented chicki). The results are in line with the study reported by Chetana & Sunkireddy [3] in which groundnut was substituted with flex seeds which significantly increased ω 3 fatty acid content.

Garden cress is rich in linolenic acid. Thus, it increased almost half to double in amount in all food preparation with addition of cress seeds. Value addition with incorporation of garden cress seeds (*Lepidium sativum*), green gram dhal (*Phaseolus aureus* Roxb.) or linseed (*Linum usitatissimum*)

increased ω 3 fatty 116 mg per 100 g in the value added flakes [19]. Being rich in unsaturated fatty acids, garden cress seeds provide a good option to balance the polyunsaturated: saturated fatty acid ratio as well as to increase linolenic acid content in diet through supplemented chickki.

Mineral content

A significant ($p \leq 0.01$) increase of 61.83 per cent was found in case of control chickki (6.13 ± 0.12 mg / 100 g) with addition of roasted garden cress seeds in supplemented chickki (9.92 ± 0.16 mg / 100 g). But per cent ionizable iron increased from 11.77 (control) to 11.97 per cent (supplemented), only which might be due to increase in fibre and phytate content of seeds which inhibited the in vitro iron digestibility of product (Table 3). The calculated per cent iron bioavailability was 6.02 and 6.11 for the control and supplemented chickki. Chahal & Sehgal [16] also showed increase in iron content of groundnut chickki on addition of till in it.

Table 3: Mineral content and In vitro digestibility of control and garden cress chickki

Minerals (mg /100 g)	Control	Acceptable	t test
Iron	6.13 ± 0.12	9.92 ± 0.16	39.09**
Percent ionisable iron	11.77	11.97	
Percent iron bioavailability	6.02	6.11	
Calcium	124 ± 2.69	163.57 ± 0.85	28.91**
Zinc	2.21 ± 0.02	2.24 ± 0.01	2.83*
In vitro digestibility (%)			
In vitro starch digestibility	58.53 ± 0.68	57.92 ± 0.54	7.40**
In vitro protein digestibility	83.57 ± 0.6	82.27 ± 0.25	2.22*

Acceptable level of garden cress supplementation at 25%

Values are mean \pm SD

*Significant at 5% level

**Significant at 1% level.

The calcium content (124 ± 2.69 mg / 100 g) of chickki increased significantly ($p \leq 0.01$) to 163.57 ± 0.85 mg per 100 g with supplementation (Table 3). Chahal & Sehgal [16] also showed increased calcium content in till groundnut chickki as compared to groundnut chickki. Nathiya & Vigasini [20] also reported improved calcium content of garden cress seeds incorporated nutricookies.

Control chickki was found with 2.21 ± 0.02 mg per 100 g of zinc content while the value significantly ($p \leq 0.05$) increased to 2.24 ± 0.01 mg per 100 g in supplemented chickki. Similar

results were reported in study of Chahal & Sehgal [16] who prepared groundnut chickki by partially substituted with till.

In vitro digestibility

The perusal of the data in the Table 3 revealed that values for control and supplemented chickki was found to be 58.53 ± 0.68 and 57.92 ± 0.54 per cent for in vitro starch digestibility and 83.57 ± 0.60 and 82.27 ± 0.25 per cent for in vitro protein digestibility with significant ($p \leq 0.01$) difference for both parameters. It may be inferred that in vitro digestibility for starch and protein was found to be decreased with the addition of garden cress seeds supplementation due to its high fibre content.

Antinutritional factors

Table 4: Antinutritional factors of control and garden cress chickki

Anti Nutritional Factors (mg / 100 g)	Control	Acceptable	t test
Oxalates	72.9 ± 0.36	73.88 ± 0.47	1.15
Phytin phosphorus	284.8 ± 2.26	286.1 ± 2.46	1.3

Acceptable level of garden cress supplementation at 25%

Values are mean \pm SD

*Significant at 5% level

**Significant at 1% level.

Antinutritional factors viz. oxalate and phytin phosphorus content of chickki is presented in the Table 4. The perusal of data showed that oxalate and phytin phosphorus content was increased in the supplemented chickki. Garden cress seeds has sufficient amount of these antinutritional factors, which were responsible for the increase of these factors in the developed product.

Chickki prepared with standard formulation contained 72.9 ± 0.36 mg per 100 g oxalic acid which increased to 73.88 ± 0.47 mg/100g in supplemented chickki while, the phytin phosphorus content of control and supplemented chickki was found 284.8 ± 2.26 and 286.10 ± 2.46 mg per 100 g. Ground nuts showed large amount of phytic ($572 - 714$ mg / 100 g) and oxalic acid (131 mg/100g on wet basis) [21]. Chahal & Sehgal [16] also reported phytic acid content of ground nut as 547 mg per 100 g. It might be a reason that chickki was found with high oxalic acid and phytin phosphorus content [22,23].

Conclusion

On the basis of the findings it can be inferred that roasted garden cress seeds supplemented chickki was found richer in proximate, amino acids and fatty acid composition than control chickki. Supplementation of garden cress seeds

also improved iron, calcium and zinc content of chikki but decreased in vitro digestibility of chikki due to increased content of antinutritional factors present in it. It is suggested that trials should be performed to decrease the antinutritional factors and improve the digestibility of chikki. The product has potential to be fed to poor and malnourished children through various supplementary feeding programmers.

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