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Short communication

Iron, calcium, zinc contents (Minerals) and Anti-oxidant activity of chutneys containing 15 per cent of desi and kabuli fresh chickpea leaves at 45 days after sowing

Seema and Neelam Khetarpaul

Abstract
Chickpea leaves are a very rich source of iron (23.8 mg). It is, therefore, highly beneficial in the treatment of iron deficiency, anemia. Chickpea leaves contain high amount of oxalic acid and phytic acid etc. These anti-nutritional contents hinder the absorption of many nutrients. So different processing techniques are required to decrease the anti-nutritional contents of these leaves so as to increase the availability of minerals, especially. The iron contents in the *chutneys* containing 15 fresh chickpea leaves (45 days after sowing) of desi and kabuli chickpea varieties were ranged from 28.10 to 29.40 per cent and calcium content ranged from 22.38 to 23.13 per cent. The available zinc content ranged from 50.50 to 52.68 per cent. The phenolic compounds (1.83 to 2.08 mg GAE/100 g) and DPPH free radical scavenging activity (60.5 to 61.8 %) present in the *chutneys* incorporating 15 per cent fresh chickpea leaves (45 days after sowing) of HC-1 and C-235 had 9.5 and 9.7 mg flavonoids, respectively, per gram were higher than those having *kabuli* varieties i.e. HK-1 (8.6 mg/g) and HK-2 (8.3 mg/g).

Keywords: calcium, zinc, iron, phytic acid, oxalic acid

Introduction
Green leafy vegetables are seasonal and also highly perishable due to the high water content in their plant tissues and abundant supply during the peak season results in spoilage of large quantities. Augmenting utilization and avoiding wastage calls for employing suitable preservation techniques that are user friendly and sustainable at the household level. There is a need to preserve the nature's storehouse of nutrients through convenient processing techniques. Therefore dehydration seems to be the simplest and economical technology for preserving greens (Makobo *et al.*, 2010) [4].

Greens can be utilized in multiple ways by incorporating into existing products and formulation of health foods using techniques of dehydration. There are not many processed foods that are available, which incorporate greens. In fact the consumption of green leafy vegetables in Indian population is limited to 5-10 gram per day as against the recommendation of 100 gram per day. They can supplement the traditional food products. These leaves can be used fresh as well as processed and then utilized in value addition of traditional Indian recipes. The basic idea is to find novel methods by which consumption of greens can be increased. Commonly the chickpea leaf is uni-imparipinnate, having 9-15 leaflets. The chickpea leaves of desi and kabuli varieties are pinnately open terminal leaflets. Some chickpea varieties have compound leaves (8-20 leaflets) and some have simple leaves, which are pubescent (hairy) in appearance. Chickpea leaves exude malic and oxalic acid. The colour of the leaves also varies; some being light green while others are green or dark green. Certain types possess leaflets with red margins (Agte *et al.*, 2000) [1].

Chickpea leaves are a very rich source of iron (23.8 mg). It is, therefore, highly beneficial in the treatment of iron deficiency, anaemia. Chickpea leaves contain high amount of oxalic acid and phytic acid etc. These anti-nutritional contents hinder the absorption of many nutrients. So different processing techniques are required to decrease the anti-nutritional contents of these leaves so as to increase the availability of minerals, especially. Modern science research is proving that various parts of *Cicer arietinum* L. are one of the richest sources of such nutrients

(Sankhla *et al.,* 2005) [6]. Like other green leafy vegetables, such as spinach, mustard leaves, mint, coriander leaves, *chulai* etc., chickpea leaves also contain good amount of some of the micronutrient minerals (Ibrikei *et al.,* 2003) [2] which are required to combat hidden hunger affecting 1/3rd population of our country. There was a need to explore the nutrient composition with special reference to their mineral composition, bioavailability of minerals and anti-oxidant properties of such unconventional green leaves so as to prevent micronutrient deficiencies.

Material methods

Standardization and development of products

Chutney from fresh leaves

Thirty six types of *chutneys* using fresh chickpea leaves of both desi and kabuli chickpea varieties at 10, 15 and 20 per cent levels picked up at 30, 45 and 60 days after sowing were standardized and developed as per method given below:

Table A: Ingredients used for making *chutney*s

Ingredients	Amounts		
	I	II	III
Fresh chickpea leaves (g) collected at each 30, 45 and 60 days after sowing	10	15	20
Onion (g)	55	50	45
Tomato (g)	30	30	30
Green chilli (g)	5	5	5
Salt (g)	2	2	2

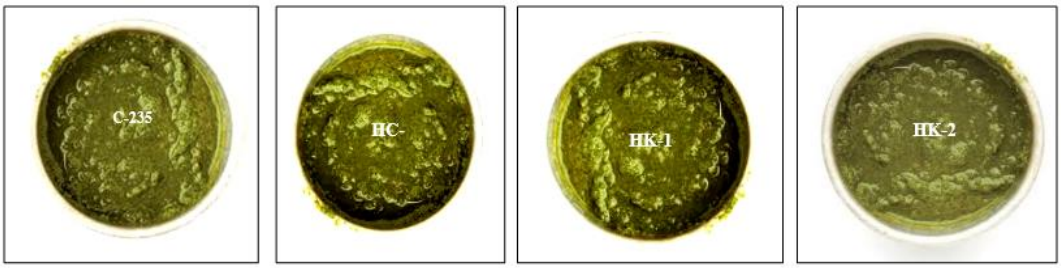

Plate A: *Chutneys* supplemented with leaves of *desi* and *kabuli* chickpea varieties

Method

1. Washed chickpea leaves.
2. Chopped onion, tomato and green chilli.
3. Mixed chickpea leaves, onion, tomato and greed chilli and ground well.
4. Added salt and served.

Sensory evaluation of products

Chutney and *sag* were prepared from the fresh leaves of *desi* (HC-1 and C-235) and *kabuli* (HK-1 and HK-2) chickpea varieties at 30, 45 and 60 days after sowing as per the standardized recipes. Developed products were evaluated for sensory parameters like colour, appearance, aroma, texture, taste and overall acceptability.

Nutritional analysis of developed products

The organoleptically acceptable products having higher mean scores of overall acceptability were further evaluated for available minerals-Fe, Ca, Zn; antioxidant activity (total phenolic contents, 2, 2 -Diphenyl-Picrylhydrazyl free radical scavenging and flavonoid content).

Results

Available mineral contents of *chutney*

The available iron contents in the *chutneys* containing 15 fresh chickpea leaves (45 days after sowing) of *desi* as well as *kabuli* chickpea varieties were found to be statistically at par with each other and they ranged from 28.10 to 29.40 per cent. Likewise, available calcium content ranged from 22.38 to 23.13 per cent. The available zinc content ranged from 50.50 to 52.68 per cent. Varietal differences did not significantly affect the available iron, zinc and calcium contents in different *chutneys* (Table 1).

Table 1: Available iron, calcium and zinc contents (%) of *chutneys* containing 15 per cent fresh chickpea leaves at 45 days after sowing (on dry matter basis)

Available minerals	*Chutney*			
	Desi chickpea		*Kabuli* chickpea	
	HC-1	C-235	HK-1	HK-2
Iron	28.20 ^{a}±1.6	29.40 ^{a}±3.4	28.10 ^{a}±4.0	28.70 ^{a}±3.3
Calcium	20.38^{a}±2.04	22.45 ^{a}±4.16	22.84 ^{a}±5.15	23.13^{a}±2.08
Zinc	51.89 ^{a}±0.09	52.68 ^{a}±0.19	50.50 ^{a}±0.21	51.90 ^{a}±0.17

Values are mean ± SE of three independent determinations.

The mean values in same row with same superscripts did not differ significantly ($p \leq 0.05$).

Anti-oxidant activity in *chutneys*

The phenolic compounds (1.83 to 2.08 mg GAE/100 g) and DPPH free radical scavenging activity (60.5 to 61.8 %) present in the *chutneys* incorporating 15 per cent fresh chickpea leaves (45 days after sowing) of HC-1 and C-235 had 9.5 and 9.7 mg flavonoids, respectively, per gram were higher than those having *kabuli* varieties i.e. HK-1 (8.6 mg/g) and HK-2 (8.3 mg/g) (Table 2). There were no intervarietal

differences in *desi* and *kabuli* chickpea leaves when their effect on flavonoid contents of *chutneys* containing their 15 per cent (45 days after sowing) fresh leaves was studied.

Table 2: Anti-oxidant activity in *chutney* prepared from 15 per cent fresh leaves at 45 days after sowing in chickpea.

Antioxidants	Chutney			
	Desi chickpea		*Kabuli* chickpea	
	HC-1	C-235	HK-1	HK-2
Phenolic compounds (mg GAE/100 g)	2.0 [a] ±0.1	2.08 [a] ±0.17	1.83 [a] ±0.19	1.91 [a] ±0.29
DPPH free radical scavenging activity (%)	61.6 [a] ±0.92	61.1 [a] ±0.70	61.8 [a] ±.14	60.5 [a] ±0.69
Flavonoids (mg/g)	9.5 [a]±0.20	9.7 [a]±0.13	8.6 [b] ±0.20	8.3 [b] ±0.23

Values are mean ± SE of three independent determinations.
The mean values in same row with same superscripts did not differ significantly ($p \leq 0.05$)
DPPH: 2, 2 – Diphenyl-I-Picrylhydrazyl.

In short, it can be said that the overall acceptability of the *chutney* was significantly ($P \leq 0.05$) better when the 10 and 15 per cent fresh leaves of both *desi* and *kabuli* chickpea varieties were incorporated in the chutney, collected at 45 days after sowing. Total available minerals (Fe, Ca and Zn) were not affected by any supplementation levels of leaves of chickpea varieties. Antioxidant activity in *chutney* having leaves of *desi* chickpea varieties were significantly ($p \leq 0.05$) affected.

Discussion

The total calcium content (22.38 to 23.13 per cent), total iron content (28.10 to 29.40 per cent) were found to be the highest in *chutney* containing 15 per cent fresh leaves of chickpea varieties at 45 days after sowing. Oyeyemi *et al*. (2014) [5] reported the calcium content of *M. arboreus* and *S. sporgonophora* leaves as 90.08 and 81.90 mg /100 g, respectively. The calcium content of *chutney* having leaves of chickpea were higher than the sole leaves of *M. arboreus* and *S. sporgonophora*.

Available iron was 28.10 to 29.40 per cent in *chutney* and available zinc was in the range of 50.50 to 52.68 per cent, may be due to low amount of antinutrients and iron content in the leafy vegetables varied within wide range. Karmakar *et al.* (2013) [3] found that utility of the vegetables as a source of iron in our daily diet, the requirement of iron for an adult woman and man are 18 mg and 8 mg per day (WHO and FAO, 2004) [7]. The results of the study if compared, then *chutney* for chickpea leaves can provide adequate amount of iron to daily needs. The phenols contents of the *chutney* ranged from 1.83 to 2.08 mg GAE/100 g, DPPH free radical scavenging activity were 60.5 to 61.8 per cent and flavonids contents were 8.3 to 9.7 mg /g. Flavonoids were maximum in *chutney.*

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