Research Article

Proximate Composition and Mineral Content of Selected Chickpea Cultivars

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Abstract | Chickpea (*Cicer arietinum*) are an important source of nutrient and can be eaten either as salad or cooked as leafy green and their grain can be consumed as curries. Samples of tender leaves, green pods, green grains, Mature pods and Mature grains of seven different Chickpea cultivars KK-1, KK-2, KK-3, Chattan, Lawaghir, Sheenghar, Fakhar-e-Thal, were obtained from Karak Research Station Ahmad Wala and evaluated for proximate composition and mineral contents. The data related to proximate composition and mineral profile showed significant difference (P<0.05) by comparing cultivars and edible parts. Proximate composition (%) of the cultivars showed that Moisture (80.84) and Ash (3.50) were high in Lawaghar, Crude fiber (6.60) in KK-2, Crude protein in Chattan (7.87) while Crude fat (2.22) was high in KK-1. Among the edible parts, Moisture (85.54) and Ash (3.54) were high in Green grains while Crude fiber (6.38), Crude protein (8.29) and Crude fat (1.99) were maximum in Tender leaves. Mineral (mgKg^{-1}) content of the cultivars showed that Na (38.3), Pb (0.30) and Cu (0.09) were high in Sheenghar, Cr (0.36), Ni (0.92) in KK-2, Fe (0.29) in KK-3, P (0.28) in Chattan while Mg (0.90) was high in Fakhar e Thal. In parts Na (40.2), P (0.24), Pb (0.32) and Mg (0.34) were high in Green grains, K (84.57), Cu (0.09) and Fe (0.22) in Tender leaves, Cr (0.36) in Green pods while Ni (0.69) and Zn (0.18) were maximum in mature pods. Chlorophyll was high (52.85) in Tender leaves. It was concluded from the data that cultivars varied in it nutritional composition and also the parts contained an appreciable amount of nutrients which along with grains may be utilized in daily diets or any other food formulation.

Introduction

Chickpea, also known as Garbanzo bean or Bengal gram (Lev-Yadun *et al.*, 2000) cultivated in many parts of the world. Chickpea does not require more labour work and its production is more efficient than other crops (Shiferaw *et al.*, 2007). Most of the people in the world used chickpea as a source of food, mostly for their protein content (FAO, 2008).

Among the major types of chickpea, the two important ones are Kabuli chickpea that is found in Asia and USA. The seeds of this type are larger in size and having white color. The 2nd one is known as desi chickpea; the seeds of this type are small in size and the color is light brown. Desi type is cultivated mainly in India and East Africa (Rincon *et al.*, 1998).

The area under pulses cultivation in Pakistan is 1-1.7

M ha where major portion of the area is covered by chickpea that is 70% while lentil, mung, mash is 27% and minor pulses covered an area by 3%. The total area under pulse cultivation in Khyber Pakhtunkhwa is 10.2 M ha where about 37600 ha are covered by chickpea (gram) with net production of 20,000 tonnes and average yield of 531.9 kg ha^{-1} (ASP, 2010-11). Chickpea is able to fix atmospheric Nitrogen, so there is no need of (N) addition to the crop and in rotation, it enhances N content of soil and increases yield of subsequent cereal crops (Aslam *et al.*, 1997). The chickpea has the property of fertility restoration i.e. water and nutrients of the soil (Ben *et al.*, 2008). As chickpea is very nutritive and soil helping crop like other legumes .The present project was design to study the nutritional components of different edible parts during growing stages of plants of different cultivars with objectives keeping in mind such as to compare different cultivars of chickpea for their nutrients i.e. minerals and proximate composition. Comparing nutritional composition of different parts of chickpea cultivars used for eating purpose during plant growing stages. And to highlight the importance of different parts like leaves and green pods of chickpea along with seeds, which is used as Chola or Kabuli channa in daily cookings.

Materials and Methods

Samples of leaves, green pods and mature seeds were collected from Agricultural Research Station Ahmad Wala Karak. The samples of different parts at different growing stages were collected and brought to the Laboratory of Agricultural Chemistry and was analyzed for different parameters, particularly for proximate composition and mineral content.

Sample collection

The samples of seven chickpea cultivars namely Karak-1(KK1), Karak-2 (KK2), Karak-3 (KK3), Sheenghar, Lawaghar, Chattan, Fakhar-e-Thal were collected from Agriculture Research Station Ahmad Wala Karak. All the samples were collected in one kg paper bags and were brought to the laboratory, where they were washed and then air dried. After air drying the sample was tested for chlorophyll content. A part of the sample was used for moisture determination. The rest of the samples were placed at 70 ^{o}C. The oven temperature was increased up to 100 ^{o}C for complete drying. The samples were then ground with laboratory grinder and stored in papers bags for further analysis.

Proximate composition

Samples of leaves, green pods and pulses were analyzed for crude protein, crude fiber, crude fat, ash and moisture by standard methods of AOAC (2000).

Moisture content

Oven drying method was used for moisture determination. Petri dish was placed in oven and the oven temperature was kept at 105°C ±1°C. The weight (wt.) loss in percent was calculated as follows.

$$Moisture\ content\ (\%) = \frac{Wt.loss\ on\ drying}{Wt.of\ sample} \times 100$$

Ash content

Direct ignition method was used for ash content determination. One gram of each sample was placed in cleaned, dried pre-weighted crucibles. The samples were charred and kept in furnace at 600 °C. Percent Ash was calculated as follows.

$$\%\ Ash = \frac{Wt.of\ ash}{Wt.of\ sample} \times 100$$

Crude fat

Crude Fat was determined by Soxhlets methods using Soxhlets apparatus. Crude fat was extracted with petroleum ether and calculated by the following formula.

$$\%\ fat = \frac{wt\ of\ ether\ extract\ \times 100}{wt\ of\ sample}$$

Crude protein

Kjeldahl method was used for crude protein determination. In the presence of digestion mixture, the sample was digested by heating with concentrated sulphuric acid. The mixture was then made alkaline. The ammonia so released was collected in (4%) boric acid solution and titrated against standard normal HCl. Total crude protein was calculated by multiplying the amount of nitrogen with the appropriate factor.

$$Crude\ protein\ (\%) = \%N \times 6.25$$

$$\%N = \frac{(S - B) \times N \times 0.014 \times D \times 100}{wt\ of\ sample \times V}$$

Crude fiber

Assay: Two gram chickpea sample was first acid digested with 200ml of 1.5% HCl, later with 200ml of 1.5% NaOH. Then the digest was oven dried weighed and ashed (550 °C for 3 hour's) and calculated by the following formula.

$$\%\ crude\ fiber = \frac{(A - B) \times 100}{C}$$

Where;
A= Crucible with dry residues (g); B= Weight of cruicible with ash (g); C= Weight of sample (g)

Phosphorus determination
Phosphorous was determined spectrophotometer method using SP3000+ spectrophotometer. Mixed reagent, ammonium molebdate and antimony potassium tartarate in one liter of 5N H_2SO_4 were used. The color developing reagent was prepared by adding 370 mg ascorbic acid to 70 ml of mixed reagents.

Standard phosphorous solution
Standard series (10, 20, 30 and 40 mg/L) prepared from $K_2 H_2 PO_2$, samples and blank were treated with coloring regent and blue color developed after 15 minutes were observed in spectrophotometer. The amount was calculated using the following formula.

$$mg\ kg - 1 = Graphical\ reading \times dilution\ factor \times 100 \times \frac{1000}{Wt.of\ sample}$$

Flame photometer
Na and K were determined by flame photometer (USDA, 1954). Na standard prepared from NaCl and K standard prepared from KCl were read by the flame photometer after making zero with blank knobe. Samples reading was recorded and compared with their respective standards.

Atomic absorption spectroscopy
For the purpose of identification of trace elements i.e. copper (Cu), zinc (Zn), iron (Fe), magnesium (Mg), chromium (cr), nickel (Ni), lead (pb) Sandell (1959), O'Dell *et al.* (1972) and macro analysis levels with modification (Sattar and Chaudary, 1978) methods were employed.

Chlorophyll meter
The chlorophyll reading was taken on fresh leaf basis with the help of At leaf chlorophyll meter (Ahmad *et al.*, 2012).

Statistical analysis
The data was statistically analyzed (STATISTIX) using two factorials completely randomized design (CRD). The Least Significant Difference (LSD) was performed at a significant level of 5% (P<0.05) for comparison of mean values (Steel *et al.*, 1997).

Results and Discussion

Seven different cultivars experimentally plotted in Karak Research Station Ahmad Wala were sampled at different edible stages. Those samples were analyzed for various chemical parameter which were present as follow.

Table 1 shows proximate composition of cultivars. The data showed that the mean moisture content was higher in Lawaghar (84.20%) followed by Sheenghar (83.83%), while the lowest moisture content (78.67%) were found in KK-3. Crude fiber showed that highest mean value of crude fiber was found in KK-2 as 6.60% that was followed by Sheenghar having the value of 6.41%. The minimum value (5.14%) of crude fiber content was found in Chattan cultivar. Crude protein ranged from 5.78 to 7.87% in the cultivars. The maximum (7.87%) crude protein was found in Chattan followed by KK-2 (7.48%), while the minimum crude protein (5.78%) was detected in KK-3. Ash content ranged from 2.09 to 3.50%. The maximum ash content (3.50%) was recorded in KK-2 followed by Sheenghar (3.43%), while Chattan appeared having the lowest ash content (2.09%) in the selected cultivars. The highest crude fat (2.22%) was found in KK-1 followed by 1.88% both in Chattan and Lawaghar, while the lowest value (1.58%) was determined in Fakhar-e-Thal, all the constituents varied significantly among the selected cultivars.

Table 1: *Proximate composition (%) of different chickpea cultivars.*

Proximate composition	Cultivars						
	KK-1	KK-2	KK-3	Chattan	Lawaghar	Sheenghar	Fakhar.e.Thal
Moisture	79.16d	81.83b	78.67d	80.84c	84.20a	83.83a	79.53d
Crude fiber	5.19d	6.60a	5.26cd	5.14d	5.69b	6.41a	5.55bc
Crude Protein	6.70bc	7.48a	5.78d	7.87a	6.45c	6.49c	6.97b
Ash Content	2.40bc	2.09c	2.83ab	2.20bc	3.50a	3.33a	3.43a
Crude Fat	2.22a	1.80b	1.79bc	1.88b	1.88b	1.87b	1.58c

KK-1=karak-1 KK-2=Karak-2 KK-3=Karak-3.

The proximate composition of different parts of the cultivars were presented in Table 2. Proximate composition in different parts was varied significantly among different parts (P<0.05). The mean moisture content of different parts showed that immature grain contained higher moisture content (85.54%). The highest mean value of crude fiber content among the parts was found in leaves which were recorded as 6.38% and the lowest value (5.23%) was found in immature grain. Crude protein was maximum (8.29%) in leaves. The mean ash content was highest (3.54%) immature grain. Crude fat content showed that leaves consist of maximum crude fat content (1.99%), while the lower value (1.75%) was found in immature grain.

Table 2: *Proximate composition (%) of different edible plant parts of chickpea cultivars.*

Proximate composition	Edible parts				
	Tender leaves	Green pods	Green grains	Mature pods	Mature grains
Moisture	78.80b	79.12b	85.54a	_	_
Crude fiber	6.38a	5.39c	5.23c	5.94b	5.52c
Crude Protein	8.29a	5.71d	6.63c	6.49c	6.98b
Ash Content	2.16 c	2.79b	3.54a	_	_
Crude Fat	1.99a	1.81ab	1.75b	1.89ab	1.86ab

Table 3: *Mineral and chlorophyll composition (mg kg^{-1}) of different chickpea cultivars.*

Mineral +Chlorophyll	Cultivars						
	KK-1	KK-2	KK-3	Chattan	Lawaghar	Sheenghar	Fakhar-e-Thal
Na	31.81d	33.00b	32.21c	32.62b	31.31e	38.3a	31.45de
K	52.98a	45.98d	50.26b	47.65c	45.90e	44.90g	45.02f
P	0.18bc	0.13cd	0.14bc	0.28a	0.07d	0.20b	0.17bc
Cr	0.15g	0.36a	0.20f	0.32b	0.23e	0.26d	0.30c
Pb	0.18f	0.24d	0.21e	0.29b	0.17g	0.30a	0.26c
Cu	0.03c	0.05b	0.05b	0.02d	0.03c	0.09a	0.03c
Ni	0.56c	0.92a	0.51d	0.45e	0.45e	0.62bc	0.77ab
Mg	0.32e	0.36b	0.34c	0.26f	0.13g	0.33d	0.39a
Zn	0.17b	0.11f	0.12e	0.10g	0.20a	0.13d	0.14c
Fe	0.18b	0.08d	0.29a	0.07e	0.17c	0.07e	0.17c
Chlorophyll	41.90a	35.98ab	0.21ab	33.12b	34.50ab	23.57c	33.05b

KK-1=karak-1 KK-2=Karak-2 KK-3=Karak-3

Satelo *et al.* (1987) reported moisture content in chickpea cultivars, which was the same as the present study. Moisture content reported by Shad *et al.* (2009) was somewhat lower from the present study

that might be due to variety difference or difference in location. These results were in agreement to those obtain by Guo *et al.* (2008) who reported crude fiber in the pressure cooked raw and roasted seeds of chickpea. Balojon and Fetuga (1986) and Hassan *et al.* (2005) also work in the same direction, supporting the present study. The results were agreed also to the findings of Khatoon and Parkash (2004) and also that of Sabinas *et al.* (2006). Tsialtas *et al.* (2002) determined ash content in vegetative parts of chickpea. Ash content (1.06%) of the whole chickpea flour was also reported by Sanchez-vioque *et al.* (1999). Alajaji and El-Adawy (2006) reported crude fat content during cooking experiment of chickpea which supported the present study. Smith *et al.* (1980) also reported crude fat of kabuli and desi type chickpea.

Mineral and chlorophyll content of cultivar were presented in Table 3. The mean value of Na in Sheenghar (38.36 mg kg^{-1}) was highest followed by KK-2 (33.00 mg kg^{-1}). Lawaghar cultivar contained lowest value of sodium content (31.31 mg kg^{-1}). Potassium was highest (52.98 mg kg^{-1}) in KK-1 followed by KK-3 that was recorded as 50.26 mg kg^{-1}. The minimum value of potassium (44.90 mg kg^{-1}) was found in Sheenghar cultivar. The phosphorus content ranged from 0.07 to 0.28 mg kg^{-1}. Chattan cultivar appeared having the highest phosphorus (0.28 mg kg^{-1}) followed by Sheenghar (0.20 mg kg^{-1}), while the lowest phosphorus content (0.07 mg kg^{-1}) was determined in Lawaghar. The chromium that ranged from 0.15 to 0.36 mg kg^{-1} having highest value KK-2 (0.36 mg kg^{-1}) followed by Chattan (0.32 mg kg^{-1}), while the minimum value was observed in KK-1 (0.15 mg kg^{-1}). The mean value of lead in Sheenghar (0.30 mg kg^{-1}) was highest followed by Chattan (0.29 mg kg^{-1}). The lead appeared as having the minimum value (0.17 mg kg^{-1}) in Lawaghar cultivar. Copper content in chickpea was highest (0.09 mg kg^{-1}) in Sheenghar followed by 0.05 mg kg^{-1} both in KK-2 and KK-3. The copper appeared as having the minimum value (0.02 mg kg^{-1}) in Chattan cultivar. The KK-2 contained highest value (0.92 mg kg^{-1}) of nickel followed by Fakhar-e-Thal (0.77 mg kg^{-1}) and the lowest mean content of nickel was found in Chattan and Lawaghar (0.45 mg kg^{-1}). Magnesium content in chickpea cultivars showed that the highest mean value (0.39 mg kg^{-1}) was found in Fakhar-e-Thal followed by KK-2 that was recorded as 0.36 mg kg^{-1}. The minimum value (0.13 mg kg^{-1}) of magnesium was recorded in Lawaghar cultivar. Zinc had maximum value in Lawaghar (0.20 mg kg^{-1}

¹) followed by KK-1 (0.17 mg kg⁻¹), while Chattan contained lowest zinc content (0.10 mg kg⁻¹). The iron maximum value (0.29 mg kg⁻¹) was recorded in KK-3 followed by KK-1 (0.18 mg kg⁻¹), While the lowest value was found in Chattan (0.07 mg kg⁻¹) and also in Sheenghar (0.07 mg kg⁻¹). The Table 3 also showed that it was highest in KK-1 (41.90 mg kg⁻¹) followed by KK-3 where it recorded as 36.15 mg kg⁻¹. Sheenghar cultivar appeared having the lowest chlorophyll content (23.57 mg kg⁻¹).

Mineral and chlorophyll content of different parts were presented in Table 4. Considered the sodium content in parts, the highest mean value (40.92 mg kg⁻¹) was found in immature grain and the lowest value (13.00 mg kg⁻¹) in leaves. The highest mean value of potassium was found in leave which were recorded as 84.57 mg kg⁻¹ and the lowest value (30.70 mg kg⁻¹) was found in mature grain. The mean phosphorus content of different parts showed that immature grain consist maximum value (0.24 mg kg⁻¹). Chromium content was high (0.36 mg kg⁻¹) in immature grain and pod. Lead was found high in mature grain (0.41 mg kg⁻¹) and lowest value was found in mature grain plus pods that was found as 0.11 mg kg⁻¹. Copper was found in leaves which were recorded as 0.09 mg kg⁻¹ and rest of the part contained 0.02 mg kg⁻¹ of copper. Nickel was found high (0.69 mg kg⁻¹) in mature grain and the lowest value (0.53 mg kg⁻¹) was found in immature grain. The highest mean value (0.34 mg kg⁻¹) of magnesium was found both in leaves and immature grain. Zinc was high (0.18 mg kg⁻¹) in mature grain. Leaves consist of maximum iron value (0.22 mg kg⁻¹). Comparing the various parts, the highest mean value of chlorophyll was found in leaves which were recorded as 52.85 mg kg⁻¹ and the lowest value was found in immature grain that was found as 15.22 mg kg⁻¹.

The present study was supported by Khalil and Manan et al. (1990) who studied different chickpea cultivars for their chemical composition. These findings were associated with the study being reported by Thavarajah et al. (2009). Lelaboye and Pikuda (2009) also reported phosphorus content in chickpea cultivars, which showed the same range as the present study.

The study of Koch (1996) supported the present work who studied chromium in chickpea cultivar. Gajewska and Sklodowska (2005) studied chromium content in contaminated plant, which agreed to the present study.

Table 4: *Mineral and chlorophyll (mg kg⁻¹) composition of different edible parts of chickpea cultivars.*

Minerals + Chlorophyll	Edible parts				
	Tender leaves	Green pods	Green grains	Mature pods	Mature grains
Na	13.00e	40.23b	40.92a	35.07d	35.57c
K	84.57a	45.21b	43.67c	30.70e	33.48d
P	0.15c	0.22b	0.24a	0.11d	0.11d
Cr	0.07e	0.36a	0.20d	0.32c	0.35b
Pb	0.20c	0.14d	0.32b	0.41a	0.11e
Cu	0.09a	0.02c	0.04b	0.04b	0.02c
Ni	0.64b	0.64b	0.53d	0.69a	0.56c
Mg	0.34a	0.26c	0.34a	0.26c	0.31b
Zn	0.05e	0.15c	0.17b	0.18a	0.14d
Fe	0.22a	0.17b	0.10e	0.14c	0.12d
chlorophyll	52.85a	_	15.22b	_	_

Wierzbicka (1995) studied different chickpea cultivars for their chemical composition and reported lead in considerable amount. The same observation of heavy metal was also reported by Herrero et al. (2003) that agreed with the present study.

Conclusions and Recommendations

Chickpea cultivars were different with respect to its nutritional components, where Sheenghar showed most of the minerals in larger amount as compared to other ones. Leaves of chickpea, which is used as saag, contained higher values of different nutrients as compare to other parts of the chickpea plants. It is recommended that chickpea cultivars, like in the present study Sheenghar, preferably be used for particular nutritional formulations. Also, along with Chana (seeds of the chickpea plants) leaves and green pods should be used to utilized maximum nutritional benefits out of chickpea plants.

Novelty Statement

Novelty of this research study is to highlight importance of chickpea leaves in stem along-with grains that are usually used in curries.

Author's Contribution

Arshad Mehmood Khattak: Principal author who conducted thesis research.
Saleem Ullah: Supervised the thesis work.

Farida Anjum: Helped in Lab. experiments.
Hamid Ullah Shah: Provided Lab. facilities.
Sahib Alam: Helped in Lab. experiments and thesis write up.

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