Doi: HTTPS://DOI.ORG/10.23910/2/2023.0517

Assessing the Nutritional and Antinutritional Components of Promising Kabuli Chickpea (*Cicer arietinum* L.) Genotypes

Tajender Kumar, Timbadiya P. N., Kandoliya U. K.*, Parakhia M. V. and Gajera H. P.

Dept. of Biotechnology, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat (362 001), India

Corresponding Author

Kandoliya U. K.
e-mail: uk@jau.in

Article History

Article ID: IJEP0517
Received on 12th February, 2023
Received in revised form on 01st May, 2023
Accepted in final form on 19th May, 2023

Abstract

The present investigation on "Assessing the Nutritional and antinutritional componants of promising kabuli chickpea (*Cicer arietinum* L.) genotypes" was carried out with an objective to analyze different 20 promising genotypes of kabuli chickpea for various nutritional and anti-nutritional components. The highest protein content (25.37%) and phytic acid (12.29 mg g^{-1}) were recorded in kabuli chickpea genotype GJGK-1828. The highest value of total sugar content was observed in ICCV-191310 (4.73%) and maximum ash content was found in ICCV-191302 (3.47%). The minimum phytic acid was recorded in genotype ICCV-191301(10.43 mg g^{-1}) which found distant genotypes in dendrogram prepared using biochemical data. The higher trypsin inhibitor was recorded in kabuli chickpea genotype GJGK-1826 (10.33TIU/mg) and lowest trypsin inhibitor content noticed in genotype ICCV-191302 (14.33TIU/mg) and both were fall in different cluster of dendrogram. Minimum value of total phenol was found in ICCV-181314(87.87 mg 100 g^{-1}) and maximum value was observed in kabuli chickpea genotype GKGK-1826 (93.98 mg 100 g^{-1}). Thus, the wide variability of nutritional and antinutritional parameters was observed among the genotype studied.

Keywords: Kabuli chickpea, phytic acid, protein, phenol, trypsin inhibitor

1. Introduction

Although the pulses and legume crops are self-pollinated crops, it showed remarkable variability in biochemical composition of seeds (Saba et al., 2015). It also showed very wide variety of response to altered environmental condition like disease stress (Kandoliya and Vakhariya, 2013a; Patel et al., 2015), abiotic stresses (Patel et al., 2019 a ; Shaikh et al., 2021; Trivedi et al., 2018) as well as application of various chemicals and hormones (Patel et al., 2019 b; Shaikh et al., 2022; Solanki et al. 2018). Chick pea (*Cicer arietinum* L.) also being a self pollinated pulse crop showed significant degree of genetic variability (Kandoliya and Vakhariya, 2013 b) among the different varieties. Generally, it is widely farmed as a source of protein in tropical, sub-tropical, and temperate climates. The desi (small seeds, angular ram's head shape, and colorful seeds with high percentage of fiber) and kabuli (big seeds, irregular rounded, owl's-head shape, and beige colored seeds with low percentage of fiber) types of cultivated chickpeas are described as drought-tolerant, cool-season legumes (Agarwal et al., 2012). Chickpea seeds are low in fat and high in protein, carbohydrates, fiber, minerals, and vitamins, making it one of the most nutritionally balanced pulses for human consumption (Jukanti et al., 2012). Chickpeas are high in both protein and carbohydrates. However, antinutritional elements in legume seeds, such as trypsin inhibitor, phytic acid,phenolic compounds, raffinose series oligosaccharides (RFOs), saponin, and tannins have a deleterious impact on their nutritional use (Wang et al., 2010). Thus the present investigation was carried out to find out variability in self pollinated crop like chickpea with respect to nutritional alongwith a some of the antinutritional parameters.

2. Materials and Methods

The present investigation on "Assessing the Nutritional and antinutritional components of promising kabuli chickpea (*Cicer arietinum* L.) genotypes" was conducted at Food Testing Laboratory, Department of Agricultural Biotechnology, JAU, Junagadh, during 2020-21. The seeds of promising genotypes were obtained from Pulse Research Station, JAU, Junagadh and used for different biochemical analysis as under.

Protein content from the chickpea seed was analyzed as per the method described by Lowry et al. (1953) and calculated by using Bovine serum albumin as standard. The total carbohydrate content was estimated by Anthrone method (Roe, 1955). Total soluble sugars was determined by the method of Dubois et al. (1956) using phenol reagent. The calculation was done with the help of standard curve prepared from glucose solution and results were expressed on per cent basis. Ash and total lipid contents were determined according to Anonymous (2005).

From the antinutritional factors analyzed, Phytic acid was determined according to Latta and Eskin (1980).Total phenol was estimated by using suitable aliquot from methanol extract as per described by Bray and Thorpe, 1954. A standard graph was prepared using pyrocatachol ranging between 10-50 µg concentrations.

The trypsin inhibitor activity was measured indirectly by inhibiting the activity of trypsin. A synthetic substrate (BAPNA) is subjected to hydrolysis by trypsin to produce yellow colored p-nitroanilide. The degree of inhibition by the extract of the yellow color production was measured at 410 nm in a spectrophotometer by Manjunath et al. (1983).

3. Results and Discussion

3.1. Nutritional factors

The protein content generally indicates that its intake can contribute to the variety of body functions such as growth, repair and maintenance (replacement of wear and tear of tissues) of body. Protein present in the chickpea seeds is responsible for its higher nutritional value. Protein content in the genotypes of chickpea seeds in this experiments was observed between 22.50 to 25.37% (Table 1). It was observed that the genotypes varied significantly in respect of protein content. Highest protein content was recorded in kabuli chickpea genotype GJGK-1828 and lowest protein content was found in genotype KAK-2. Similar range of protein content found by Pankaj et al. (2011) who reported that thirty distinct chickpea genotypes showed protein content ranged from 19.98-25.23%. Similar results in protein content in desi and Kabuli chickpea germplasm have also been reported by Amjad et al. (2006), Amir et al. (2007) and Atul et al. (2012).

The results of total carbohydrates also varied significantly in different genotypes (Table 1). Total carbohydrate content in kabuli chickpea seeds ranged between 47.34 to 50.98%. Highest value was found in kabuli chickpea genotype ICCV-191316 and lowest value was noted in kabuli chick pea genotype ICCV-191317. Similarly, Singhai and Shrivastava (2006) reported total carbohydrates content in *Cicer arietinum* varieties and other legumes. JG-11 had the highest (50.4%) total carbohydrates content and the lowest (37.2%) total carbohydrate content in JG-218 in respective experiment. The result was also closely supported by Shad et al. (2009).

Total sugars content in kabuli chickpea seeds ranged between 2.84 to 4.73% (Table 1).The data regarding to total sugars content varied significantly in different genotypes. Highest value was found in kabuli chickpea genotype ICCV-191310 and lowest value was recorded in kabuli chickpea genotype ICCV-191312. This result is in accordance with Rehman (2007) who reported that highest total soluble sugar was recorded in a ranged from 7.16% to 4.15%.

Total lipid content in kabuli chickpea seeds ranged between 4.53 to 6.52 percent (Table 1). Highest lipid content was found in kabuli chickpea genotype PKV-4 and lowest value was recorded in kabuli chickpea genotype ICCV-191315. Shad et al. (2009) also reported lower values (2.05%) for crude fat content in desi chickpea varieties. Fat content of 3.40-8.83% and 2.90-7.42% in kabuli and desi type chickpea seeds respectively was also reported by Wood and Grusak (2007).

Total Ash content in kabuli chickpea seeds in present experiment ranged between 2.48 to 3.47% (Table 1). The results of total Ash varied significantly in different genotypes. Maximum ash content was found in kabuli chickpea genotype ICCV-191302 and minimum value was noted in kabuli chickpea genotype ICCV-191301. These results were comparable to those investigated by earlier workers (Amjad et al., 2006; Amir et al., 2007).

3.2. Anti nutritional factors

Among the anitinuritional factors studied, phytic acid content

Table 1: Nutritional content in seeds of chickpea genotypes

Sl. No.	Genotypes	P (%)	TC (%)	TSS (%)	TL (%)	TA (%)
1.	ICCV–191306	22.95	48.81	3.94	4.67	2.56
2.	ICCV–191305	23.85	48.01	3.19	5.68	3.26
3.	ICCV–181314	24.97	50.66	4.32	5.30	2.57
4.	ICCV–191313	23.33	48.35	3.49	5.66	3.32
5.	ICCV–191318	24.12	48.44	3.32	5.18	2.49
6.	ICCV–191312	24.70	48.32	2.84	4.55	2.73
7.	ICCV–191302	22.92	50.09	4.01	5.51	3.47
8.	ICCV–191310	23.21	48.11	4.73	6.09	2.51
9.	ICCV–191311	25.02	49.12	3.75	4.79	2.68
10.	ICCV–191303	23.44	48.94	3.32	5.46	2.72
11.	ICCV–191316	25.18	50.98	3.10	5.24	3.41
12.	ICCV–191308	24.29	49.40	4.45	4.63	2.80
13.	ICCV–191301	24.97	47.90	4.19	6.44	2.48
14.	ICCV–191317	22.94	47.34	3.72	5.69	3.40
15.	ICCV–191315	24.94	48.39	3.60	4.53	3.17
16	KAK–2	22.50	50.58	3.15	5.74	2.79
17.	PKV– 4	24.25	49.72	4.30	6.52	3.45
18.	GJGK–1828	25.37	48.97	3.66	5.47	2.63
19.	GJGK–1826	24.83	49.21	3.28	5.00	2.73
20.	GJGK–1812	24.09	49.97	3.27	5.08	3.36
	SEm±	0.26	0.29	0.14	0.15	0.16
	CD (p=0.05)	0.74	0.84	0.42	0.44	0.47
	C.V.%	3.72	2.05	14.29	10.88	12.79

P: Protein (%); TC: Total carbohydrates (%); TSS: Total soluble sugars (%); TL: Total lipid (%); TA: Total ash (%)

in kabuli chickpea seeds significantly varied between 10.43 to 12.29 mg g^{-1} (Table 2). Minimum phytic acid was recorded in kabuli chickpea genotype ICCV-191301 and maximum phytic acid was noticed in kabuli chickpea genotypeGJGK-1828 in present investigation. The present finding is similar to Shi et al. (2018) who reported that phytic acid content in whole chickpea, split chickpea and desi chickpea was found to be 11.33 mg g^{-1}, 11.53 mg g^{-1} and 14.00 mg g^{-1} respectively. Tripathi et al. (2018) who noted that phytic acid content ranged from 8.44 mg g^{-1} to12.89 mg g^{-1} in the sixteen chickpea genotypes.

Trypsin inhibitor content in kabuli chickpea seeds ranged between 10.33 to 14.33 TIU/mg (Table 2). The results of Trypsin inhibitor content varied significantly in different genotypes. Minimum trypsin inhibitor content was recorded in kabuli chickpea genotype GJGK-1826 and maximum content was noticed in kabuli chickpea genotype ICCV-191302. The total phenol content in kabuli chickpea seeds ranged between 87.87 to 93.98 mg 100 g^{-1} (Table 2). The data regarding to total phenol content varied significantly in different genotypes. Minimum value of total phenol in kabuli chickpeagenotype was found in ICCV-181314 and. maximum value was observed in kabuli chickpea genotype GKGK-1826. The similar results have also been reported by Segev et al. (2010). Zielinski (2002), Yadav et al. (2011) have also determined the value of total phenol from 101 to 255 mg 100 g^{-1} which is more from the range of present study.

Dendrogram prepared (http://genomes.urv.cat/ UPGMA/ UPGMA boot_v12.cgi) using all the biochemical data analyzed also showed wide variability among genotype studied (Figure 1).The distant genotype ICCV 191301 showed lower amount of total ash and higher value in total lipid(6.44 %) which remain at par with the genotype PKV-4 recorded highest fat content(6.52 %). however, genotype ICCV 191301 also showed lowest phytic acid content. The genotype GJGK-1828 recorded the highest protein content (25.37%) and highest phytic acid content (12.29 mg g^{-1}) falls in different cluster with the genotype KAK-2 having the lowest protein content (22.5%).

Table 2: Antinutrional factors in seeds of chickpea genotype

Sl. No.	Genotypes	Phytic acid (mg g-1)	Trypsin inhibitor (TIU mg-1)	Total phe-nol (mg 100g-1)
1.	ICCV–191306	10.65	12.00	88.80
2.	ICCV–191305	11.39	12.00	91.42
3.	ICCV–181314	10.72	12.67	87.87
4.	ICCV–191313	10.75	11.00	92.69
5.	ICCV–191318	12.11	13.67	93.91
6.	ICCV–191312	11.65	13.00	91.35
7.	ICCV–191302	10.57	14.33	88.86
8.	ICCV–191310	10.55	11.67	90.20
9.	ICCV–191311	11.37	12.67	93.75
10.	ICCV–191303	10.56	13.33	89.42
11.	ICCV–191316	11.01	12.67	89.42
12.	ICCV–191308	11.44	11.67	92.68
13.	ICCV–191301	10.43	11.33	93.89
14.	ICCV–191317	11.73	13.00	89.45
15.	ICCV–191315	10.50	11.33	91.52
16	KAK–2	10.61	13.67	89.75
17.	PKV– 4	11.75	11.33	91.01
18.	GJGK–1828	12.29	12.67	92.06
19.	GJGK–1826	11.19	10.33	90.65
20.	GJGK–1812	10.70	12.67	93.98
	SEm±	0.18	0.88	0.45
	CD (*p*=0.05)	0.52	2.52	1.29
	C.V.%	5.22	8.28	2.52

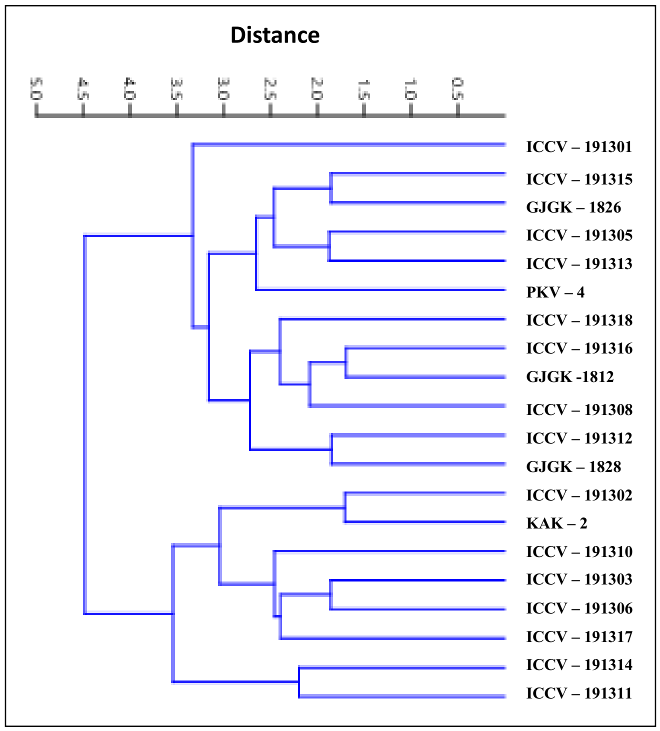

Figure 1: Dendrogram prepared using biochemical data by http://genomes.urv.cat/ UPGMA/ UPGMA boot_v12.cgi

4. Conclusion

The wide variability of nutritional and antinutritional parameters was observed among the genotype studied. The genotype GJGK-1828 recorded the highest protein content (25.37%) and highest phytic acid content (12.29 mg g^{-1}) falls in different cluster with the genotype KAK-2 having the lowest protein content (22.5%) The highest value of total sugar content was observed in ICCV-191310 (4.73%) and maximum ash content was found in ICCV-191302 (3.47%). The minimum phytic acid was recorded in genotype ICCV-191301(10.43 mg g^{-1}) which found distant genotypes in dendrogram prepared using biochemical data. The higher trypsin inhibitor was recorded in kabuli chickpea genotype GJGK-1826 (10.33TIU/mg) and lowest trypsin inhibitor content noticed in genotype ICCV-191302 (14.33TIU/mg) and both were fall in different cluster of dendrogram.

5. Reference

Agarwal, G., Jhanwar, S., Priya, P., Singh, V. K., Saxena, M. S., Parida, S.K., Garg, R., Tyagi, A.K., Jain, M., 2012. Comparative analysis of kabuli chickpea transcriptome with desi and wild chickpea provides a rich resource for development of functional marker. PLoS One 7(12), 52443.

Amir, Y., Haennia, L., You, A., 2007. Physical and biochemical difference in the composition of seeds of Algerian leguminous crops. Journal of Food Composition and Analysis 20(6), 466–471.

Amjad, I., Khalil, I.A., Nadia, A., Khan, M.S., 2006. Nutritional quality of important food legumes. Food Chemistry 97(2), 331–335.

Anonymous, 2005. Association of Official Analytical Chemists (AOAC) (2005). Official Methods of Analysis of AOAC International.18th Edition. Maryland, USA: AOAC International.

Atul, P., Singh, P., Singh, R.P., 2012. Comparative studies in relation to protein and protein profiling of desi and kabuli chickpea (*Cicer arietinum* L.) genotypes. Indian Journal of Agricultural Biochemistry 25(1), 80–83.

Bray, H.G., Thorpe, W.V., 1954. Analysis of phenolic compounds of interest in metabolism. Methods of Biochemical Analysis 1(1), https://doi.org/10.1002/9780470110171.ch2.

DuBois, M., Gilles, K.A., Hamilton, J.K., Rebers, P.A., Smith, F., 1956. Colorimetric method for determination of sugars and related substances. Analytical Chemistry 28(3), 350–356.

Jukanti, A.K., Gaur, P.M., Gowda, C.L.L., Chibbar, R.N., 2012. Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.*)* a review. British Journal of Nutrition 108(1), 11–26.

Kandoliya, U.K., Vakharia, D.N., 2013a. Induced resistance and phenolic acid accumulation in biological control of chickpea wilt by *Pseudomonas fluorescens.* Asian Journal of Bio Science 8(2), 184–188.

Kandoliya, U.K., Vakharia, D.N., 2013b. Accessing genetic variability in chickpea (*Cicer arietinum* L.) varieties differing in susceptibility to *Fusarium oxysporum f. sp. ciceri* using ISSR markers. Asian Journal of Bio Science 8(2), 165–170.

Latta, M., Eskin, M., 1980. A simple and rapid colorimetric method for phytate determination. Journal of Agricultural Food Chemistry 28(6), 1313–1315.

Lowry, O.H., Rosebrough, N.J., Farr, A.L., Randall, R.J., 1953. Protein measurement with the folin-phenols reagent. Journal of Biological Chemistry 193(1), 265–275.

Manjunath, N.H., Veerabhadrappa, P.S., Virupaksha, T.K., 1983. Estimation of Trypsin inhibitor activity. Phytochemistry 22(11), 2349–2357.

Pankaj, A., Singh, P., Singh, R.P., 2011. Evaluation of biochemical composition of desi and kabuli chickpea (*Cicer arietinum* L.) genotypes. Green Farming 2(5), 516–520.

Patel, R.S., Kadam, D.D., Kandoliya, U.K., Golakiya, B.A., 2019 a). Effect of gibberellic acid, potassium nitrate and silicic acid on enzymes activity in cowpea (*Vigna unguiculata* L. *Walp*) irrigated with saline water. Journal of Pharmacognosy and Phytochemistry 8(5), 1022–1029.

Patel, R.S., Purohit, H.B., Kandoliya, U.K., Golakiya,B.A., 2019b). Effect of gibberellic acid, potassium nitrate and silicic acid on biochemical constituents and physiological parameter in cowpea (*Vigna unguiculata* L. *Walp*) seedling irrigated with saline water. International Journal of Chemical Studies 7(6), 2162–2172.

Patel, N.J., Kandoliya, U.K., Talati, J.G., 2015. Induction of phenol and defence-related enzymes during wilt (*Fusarium udum* Butler) infestation in pigeon pea. International Journal of Current Microbiology and applied science 4(2), 291–299.

Roe, J.H., 1955. The determination of blood and spinal fluid with anthrone reagent. Journal of Biological Chemistry 212(1), 335–343.

Saba, I., Sofi, P.A., Kandoliya, U.K., Baba, Z. A., 2015. Natural variation for seed physical, biochemical and culinary traits in common bean (*Phaseolus vulgaris* L.). Current Botany 6(1), 1–8.

Segev, A., Badani, H., Kapulnik, Y., Shomer, I., Oren-Shamir, M., Galili, S., 2010. Determination of polyphenols, flavonoids, and antioxidant capacity in colored chickpea (*Cicer arietinum* L.). Journal of Food Science 75(2), 115–119.

Shad, M.A., Pervez, H., Zafar, Z.I., Zia-Ul-Haq, M., Nawaz, H., 2009. Evaluation of biochemical composition and physicochemical parameters of oil from seeds of desi chickpea varieties cultivated in arid zone of Pakistan. Pakistan Journal of Botany 41(2), 655–662.

Shaikh, K.S., Kandoliya, U.K., Gajera, H.P., 2022. Effect of growth regulators on biochemical constituents and physiological parameter in mothbean (*Vigna Aconitifolia Jacq.)* irrigated with saline water. International Journal for Research Trends and Innovation 7(8), 723–745

Shaikh, K.S., Talaviya, S.M., Kandoliya, U.K., Gajera, H.P., 2021. Effect of growth regulators on antioxidative enzymes activity in mothbean (*Vigna aconitifolia* jacq.) irrigated with saline water. International Journal of All Research Education and Scientific Methods 9(10), 1051–1064.

Shi, L., Arntfield, S.D., Nickerson, M., 2018. Changes in level of phytic acid, lectins and oxalates during soaking and cooking of Canadian pulses. Food Research International 107(1), 660–668.

Singhai, S., Shrivastava, S.K., 2006. Nutritive value of new chickpea (*Cicer arietinum L*.) varieties. Journal of Food Agriculture and Environment 4(1), 48–53.

Solanki, M.V., Trivedi, S.K., Kandoliya, U.K., Golakiya, B.A., 2018. Effect of exogenous application of salicylic acid on biochemical constituent in black gram (*Vigna mungo* L.) Hepper irrigated with saline water. European Journal of Biotechnology and Bioscienc 6(5), 28–34.

Tripathi, A., Mishra, S.P., Varma, A., Panday, D.K., 2018. Physico-chemical and antinutritional studies of chickpea. Journal of Pharmacology and Phytochemistry 7(1), 685–689.

Trivedi, S.K., Solanki, M.V., Kandoliya, U.K., Golakiya, B.A., 2018. Water. International General of Chemical Studie 6(4), 2668–2674.

Wang, N., Hatcher, D.W., Tyler, R.T., Toews, R., Gawalko, E. J., 2010. Effect of cooking on composition of bean (*Phaseolus vulgaris* L.) and chickpeas (*Cicer arietinum* L.). Food Research International 43(1), 589–594.

Wood, J.A., Grusak, M.A., 2007. Nutritional value of chickpea. In Chickpea Breeding and Management, 101–42.

Yadav, R.N.S., Archana, B., Unni, B.G., 2011. *In vitro* antioxidant and free radical scavenging activity of *Alternanthera sessilis*. International Journal of Pharmaceutical Sciences and Research 2(6), 1502–1506.

Rehman, Z., 2007. Domestic processing effects on available carbohydrate content and starch digestibility of black grams (*Vigna mungo*) and chick peas (*Cicer arietium L*.). Food Chemistry 100(1), 764.

Zielinski, H., 2002. Peroxil radical-trapping capacity of germinated legume seeds. Nahrung 46(2), 100–104.