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Biochemical and Molecular Studies on *Rhizobium* Inoculated Chickpea (*Cicer arietinum* L.) Genotypes Grown in Eastern U.P.

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ABSTRACT

Health promoting biochemical parameters of 15 distinct chickpea genotypes (Desi and Kabuli) showed wide variability in their chemical composition, crude fiber, total mineral content, total free amino acid *Rhizobium* inoculated was relatively higher than non inoculated. Reducing sugar, non reducing sugar, total sugar non inoculated was relatively higher than *Rhizobium* inoculated. Crude fibre content in chickpea ranged from 12.89-13.79% in control, *Rhizobium* inoculated 13.11-15.03%, total mineral content ranged from 3.55-3.79% in control, *Rhizobium* inoculated 4.14-4.45%, total free amino acids in chickpea seeds ranged from 2.35-2.51% in control, *Rhizobium* inoculated 2.38-2.65%, reducing sugar content in chickpea seeds ranged from 24.45-25.80% in control, *Rhizobium* inoculated 24.05-25.38%, non reducing sugar content in chickpea seeds ranged from 39.06-41.21% in control, *Rhizobium* inoculated 38.41-40.53%, total sugar content in chickpea seeds ranged from 63.51-67.00% in control, *Rhizobium* inoculated 62.46-65.91%. The research result about the biochemical characteristics of control and *Rhizobium* inoculated chickpea genotypes are expected to provide guidelines for the researches confronted with the need to use such typical food seed in India as well as in the rest of the world.

Key words: Reducing sugar, crude fiber, total free amino acid, total mineral content

INTRODUCTION

Pulses play a pivotal role and occupy a unique position in Indian agriculture by virtue of their inherent capacity to grow on marginal lands and provide protein rich diet to the vegetarian mass of the country, consumption of pulses along with cereals increase biological value of protein consumed. Amongst the leguminous crops, chickpea (*Cicer arietinum* L.) occupy an important position due to its nutritive values (17-23% protein) in large vegetarian population of the country (Ali and Kumar, 2006).

Chickpea have been shown to be rich in proteins. However, their contribution in a diet does not depend on its quality as well. The quality of a protein is known to be affected by essential amino acid composition, amino acid imbalance availability of essential amino acids, digestibility and interference in protein utilization by anti-nutritional factors. The amino acid composition of pulses has been widely studied. It has been observed that pulse proteins are mainly deficient in sulphur containing amino acids and tryptophan but are rich in lysine in which cereals are relatively deficient.

In general, chickpea proteins exhibit a wide range of variation in their essential amino acids. Cotyledon, being the major component of seed accounts for 93% of methionine and tryptophan of the whole seed while the seed coat is usually varies poor in these amino acids. The embryo is rich in methionine and tryptophan but it contributes only about 2.5% of their total quantity in seed. Environmental factors under which the pulse crops are growing influence their amino acid composition (Ali *et al.*, 2003).

Chickpea is used for human consumption as well as for feeding animals. It is eaten as both whole fried or boiled and salted or more generally in the form of the spilt pulse (dhal) which is cooked and eaten. Both husks and bits of 'dhal' form valuable cattle feed. Green foliage and green grains are also used as vegetables. Straw of gram is an excellent fodder for cattle. Parched gram is either consumed as such, or ground into flour or sattu. Gram flour (besan) is used in the preparation of various types of sweets.

Besides, this medicinal importance can not over looked scurvy patients are advised by the doctor to take germinated gram seed to get rid-off. Malic and oxalic acid collected from green leaves of gram are prescribed for intestinal disorders (CSIR, 1950). Germinated seeds are recommended as a prophylactic agent against deficiency, diseases. Keeping in view of above outmost importance of chickpea pertaining to human health, diversified use and insufficient inferences of the present investigation was undertaken.

MATERIALS AND METHODS

The present investigation on "Biochemical and molecular studies on *Rhizobium* inoculated chickpea (*Cicer arietinum* L.) genotypes grown in eastern U.P." was carried out at Student's Instructional Farm and in the laboratory of Department of Biochemistry during Rabi season of 2010-11 and 2011-12. After harvesting, the seeds were collected and stored in desiccators for the analysis of various biochemical parameters.

Reducing sugar content in chickpea seed was determined by the method of Miller (1959). Total sugar content in chickpea seed was determined by the method of Dubois *et al.* (1956). The non-reducing sugar content in chickpea seed was determined by subtraction of reducing sugar from total sugar. Non-reducing sugar = Total sugar-reducing sugar.

Crude fiber content and Total mineral content in chickpea seed was estimated with the help of method described by Hart and Fisher (1971). Total free amino acid in chickpea seed was determined by the method of Jayraman (1981).

RESULTS AND DISCUSSION

Content of crude fibre in chickpea seed are given in Table 1. Crude fibre content in chickpea ranged from 12.89-13.79% in control, *Rhizobium* inoculated 13.11-15.03%. Highest crude fibre content was reported in PUSA 362 (13.78%) followed by H82-2 (13.38%), KWR 108 (13.35%) in control, *Rhizobium* inoculated PUSA 362 (15.00%) followed by H82-2 (14.69%), KWR 108 (14.60%) and lowest value was in KKG 306 (13.00%) followed by L550 (12.90%), KAK 2 (12.86%) in control whereas, *Rhizobium* inoculated ICCV10 recorded (14.00%) followed by L550(13.15%), KAK 2 (13.10%) during 2010-11. In the second year, maximum crude fiber content was reported in PUSA 362 (13.79%) followed by H82-2 (13.39%), KWR 108 (13.34%) in control, *Rhizobium* inoculated PUSA 362 (15.05%) followed by H82-2 (14.68%), KWR 108 (14.62%) and lowest value was in KKG 306 (13.00%) followed by L550 (12.92%), KAK 2 (12.91%) in control whereas, *Rhizobium*

Table 1: Crude fibre contents (%) in chickpea seeds

	Crude fibre content (%)					
	Mean				Pooled mean	
Genotypes	2010-11 (C)	2010-11 (R)	2011-12 (C)	2011-12 (R)	(C)	(R)
Pusa-362	13.78	15.00	13.79	15.05	13.79	15.03
KWR 108	13.35	14.60	13.34	14.62	13.35	14.61
H82-2	13.38	14.69	13.39	14.68	13.39	14.69
NDG-54	13.25	14.60	13.26	14.62	13.26	14.61
Phule G5	13.11	14.55	13.12	14.57	13.12	14.56
RSG 888	13.22	14.51	13.20	14.52	13.21	14.52
C-235	13.20	14.40	13.18	14.37	13.19	14.39
DCP 92-3	13.10	14.20	13.12	14.21	13.11	14.21
Uday	13.05	14.11	13.07	14.12	13.06	14.12
Pant G 186	13.00	14.05	13.02	14.07	13.01	14.06
BG 2083	13.25	14.50	13.23	14.53	13.24	14.52
KKG 306	13.00	14.11	13.00	14.12	13.00	14.12
ICCV 10	13.11	14.00	13.12	14.05	13.11	14.03
L 550	12.90	13.15	12.92	13.17	12.91	13.16
KAK 2	12.86	13.10	12.91	13.12	12.89	13.11
CD at 5%	0.15	0.18	0.16	0.21		

Table 2: Total mineral contents (%) in chickpea genotypes

	Total mineral contents (%)					
	Mean				Pooled mean	
Genotypes	2010-11 (C)	2010-11 (R)	2011-12 (C)	2011-12 (R)	(C)	(R)
Pusa-362	3.80	4.45	3.78	4.45	3.79	4.45
KWR 108	3.66	4.23	3.65	4.22	3.66	4.23
H82-2	3.75	4.29	3.75	4.28	3.75	4.29
NDG-54	3.70	4.27	3.71	4.26	3.71	4.27
Phule G5	3.69	4.25	3.70	4.26	3.70	4.26
RSG 888	3.65	4.22	3.65	4.21	3.65	4.22
C-235	3.61	4.20	3.60	4.20	3.61	4.20
DCP 92-3	3.63	4.22	3.61	4.21	3.62	4.22
Uday	3.73	4.27	3.74	4.28	3.74	4.28
Pant G 186	3.62	4.21	3.60	4.20	3.61	4.21
BG 2083	3.72	4.28	3.73	4.29	3.73	4.29
KKG 306	3.67	4.23	3.68	4.23	3.68	4.23
ICCV 10	3.60	4.20	3.61	4.21	3.61	4.20
L 550	3.55	4.14	3.55	4.14	3.55	4.14
KAK 2	3.58	4.16	3.58	4.17	3.58	4.17
CD at 5%	0.19	0.22	0.16	0.21		

inoculated ICCV10 recorded (14.05%) followed by L550 (13.17%), KAK 2 (13.12%) during 2011-12. The results comprising to crude fibre content were found statistically significant for both the years i.e., 2010-11 and 2011-12. The results indicate to close agreement with Abdalla *et al.* (2013).

Data displayed on total mineral content in chickpea seeds are presented in Table 2. Total mineral content ranged from 3.55-3.79% in control, *Rhizobium* inoculated 4.14-4.45%. Maximum

Table 3: Total free amino acids (%) in chickpea seeds

	Total free amino acids (%)					
	Mean				Pooled mean	
Genotypes	2010-11 (C)	2010-11 (R)	2011-12 (C)	2011-12 (R)	(C)	(R)
Pusa-362	2.50	2.65	2.51	2.65	2.51	2.65
KWR 108	2.42	2.58	2.41	2.59	2.42	2.59
H82-2	2.48	2.61	2.48	2.60	2.48	2.61
NDG-54	2.45	2.59	2.46	2.60	2.46	2.60
Phule G5	2.37	2.50	2.37	2.51	2.37	2.51
RSG 888	2.46	2.60	2.47	2.61	2.47	2.61
C-235	2.27	2.41	2.26	2.42	2.27	2.42
DCP 92-3	2.38	2.50	2.39	2.51	2.39	2.51
Uday	2.35	2.47	2.36	2.48	2.36	2.48
Pant G 186	2.33	2.46	2.34	2.46	2.34	2.46
BG 2083	2.40	2.57	2.40	2.56	2.40	2.57
KKG 306	2.38	2.50	2.36	2.51	2.37	2.51
ICCV 10	2.41	2.53	2.42	2.54	2.42	2.54
L 550	2.31	2.44	2.39	2.45	2.35	2.45
KAK 2	2.34	2.38	2.35	2.38	2.35	2.38
CD at 5%	0.25	0.27	0.27	0.30		

content of total mineral was noticed in PUSA 362 (3.80%) followed by H82-2 (3.75%), Phule G 5 (3.69%) in control, *Rhizobium* inoculated PUSA 362 (4.45%) followed by H82-2 (4.29%), NDG 54 (4.27%) and lowest value was in ICCV 10 (3.60%) followed by KAK 2 (3.58%), L550 (3.55%), in control whereas, *Rhizobium* inoculated ICCV 10 recorded (4.20%) followed by KAK 2 (4.16%), L550 (4.14%), during 2010-11. In the second year, maximum total mineral content was reported in PUSA 362 (3.78%) followed by H82-2 (3.75%), NDG 54 (3.71%) in control, *Rhizobium* inoculated PUSA 362 (4.45%) followed by H82-2 (4.28%), NDG 54 (4.26%) and lowest value was in Pant G 186 (3.60) followed by KAK 2 (3.58%), L550 (3.55%) in control whereas, *Rhizobium* inoculated Pant G 186 recorded (3.61%) followed by KAK 2 (3.58%) L550 (3.55%) during 2011-12. The results pertaining to total mineral content were found statistically significant for both the years i.e., 2010-11 and 2011-12. The results are closely supported with Amir *et al*. (2006), Kaur and Singh (2007) and Saxena and Saxena (2011).

The data pertaining to the total free amino acids in chickpea seeds are presented in Table 3. Total free amino acids in chickpea seeds ranged from 2.35-2.51% in control, *Rhizobium* inoculated 2.38-2.65%. Maximum total free amino acids reported in PUSA 362 (2.50%) followed by H82-2 (2.48%), RSG888 (2.46%) in control, *Rhizobium* inoculated PUSA 362 (2.65%) followed by H82-2 (2.61%), RSG 888 (2.60%) and lowest value was in Pant G186 (2.33%) followed by L550 (2.31%), C-235 (2.27%), in control whereas, *Rhizobium* inoculated L550 recorded (2.44%) followed by C-235 (2.41%), KAK 2 (2.38%) during 2010-11. In the second year, maximum total free amino acids were reported in PUSA 362 (2.51%) followed by H82-2 (2.48%), RSG888 (2.47%) in control, *Rhizobium* inoculated PUSA 362 (2.65%) followed by RSG888 (2.61%), H82-2 (2.60%) and lowest value was in KAK 2 (2.35%) followed by Pant G186 (2.34%), C-235 (2.26%) in control whereas, *Rhizobium* inoculated L550 recorded (2.45%) followed by C-235 (2.42%), KAK 2 (2.38%) during 2011-12. The results related to total free amino acids were found statistically non significant for both the years i.e., 2010-11 and 2011-12. The results are very much supported with Chaterjee *et al*. (1977) and Iqbal *et al*. (2006).

Data on reducing sugar, non-reducing sugar and total sugar in chickpea seed have been presented in Table 4. Highest content of reducing sugar recorded in KWR108 (25.80%) followed by PUSA 362 (25.73%), H82-2 (25.74%) in control, *Rhizobium* inoculated KWR 108 (25.38%), by H82-2 (25.34%) PUSA 362 (25.30%), non-reducing sugar KWR108 (41.21%) followed by H82-2 (41.11%) PUSA 362 (41.09%) in control, *Rhizobium* inoculated KWR 108 (40.53%) followed by H82-2 (40.47%), PUSA 362 (40.42%) and total sugar H82-2 (66.85%) followed by PUSA 362 (66.81%) KWR 108 (67.00%) in control, *Rhizobium* inoculated KWR 108 (65.91%) followed by H82-2 (65.80%), PUSA 362 (65.76%) and the lowest values were recorded genotypes KKG 306 (24.54%) followed by BG 2083 (24.45%) in control, *Rhizobium* inoculated KKG 306 (24.15%) followed by BG 2083 (24.05%) (reducing sugar), BG 2083 (39.06%) followed by KKG 306 (39.21%)

Table 4: Reducing sugar, non-reducing sugar and total sugar contents (%) in chickpea seeds

	Mean				Pooled mean	
Genotype	2010-11 (C)	2010-11 (R)	2011-12 (C)	2011-12 (R)	2010-11 (C)	2011-12 (R)
Reducing sugar (%)						
Pusa-362	25.72	25.31	25.73	25.29	25.73	25.30
KWR 108	25.80	25.37	25.80	25.38	25.80	25.38
H82-2	25.74	25.33	25.74	25.34	25.74	25.34
NDG-54	25.60	25.18	25.61	25.18	25.61	25.18
Phule 95	25.57	25.18	25.58	25.18	25.58	25.18
RSG 888	25.28	24.87	25.29	24.87	25.29	24.87
C-235	24.77	24.38	24.77	24.39	24.77	24.39
DCP 92-3	25.23	24.83	25.24	24.83	25.23	24.83
Uday	24.77	24.35	24.78	24.36	24.78	24.36
Pant G 186	24.89	24.49	24.89	24.49	24.89	24.49
BG 2083	24.45	24.04	24.45	24.05	24.45	24.05
KKG 306	24.54	24.15	24.54	24.15	24.54	24.15
ICCV 10	25.29	24.89	25.29	24.89	25.29	24.89
L 550	24.97	24.57	24.96	24.56	24.97	24.57
KAK 2	25.15	24.76	25.15	24.75	25.15	24.76
CD at 5%	0.39	0.41	0.45	0.57		
Non-reducing sugar (%)						
Pusa-362	41.08	40.44	41.09	40.4	41.09	40.42
KWR 108	41.21	40.53	41.21	40.54	41.21	40.53
H82-2	41.11	40.47	41.11	40.47	41.11	40.47
NDG-54	40.90	40.22	40.91	40.23	40.9	40.22
Phule 95	40.85	40.23	40.85	40.22	40.85	40.22
RSG 888	40.39	39.73	40.39	39.72	40.39	39.72
C-235	39.58	38.95	39.57	38.96	39.58	38.96
DCP 92-3	40.31	39.66	40.31	39.67	40.31	39.67
Uday	39.58	38.90	39.58	38.90	39.58	38.90
Pant G 186	39.76	39.11	39.77	39.12	39.77	39.11
BG 2083	39.05	38.41	39.06	38.41	39.06	38.41
KKG 306	39.21	38.57	39.21	38.58	39.21	38.58
ICCV 10	40.40	39.75	40.41	39.76	40.40	39.75
L 550	39.88	39.24	39.88	39.24	39.88	39.24
KAK 2	40.17	39.54	40.17	39.54	40.17	39.54
CD at 5%	1.58	1.75	1.64	1.66		

Table 4: Continue

	Mean				Pooled mean	
Genotype	2010-11 (C)	2010-11 (R)	2011-12 (C)	2011-12 (R)	2010-11 (C)	2011-12 (R)
Total sugar (%)						
Pusa-362	66.80	65.75	66.82	65.68	66.81	65.72
KWR 108	67.00	65.90	67.00	65.92	67.00	65.91
H82-2	66.85	65.80	66.85	65.81	66.85	65.81
NDG-54	66.50	65.40	66.52	65.41	66.51	65.41
Phule 95	66.42	65.41	66.43	65.40	66.42	65.41
RSG 888	65.67	64.60	65.68	64.59	65.68	64.60
C-235	64.35	63.33	64.34	63.34	64.35	63.34
DCP 92-3	65.54	64.49	65.55	64.50	65.55	64.50
Uday	64.35	63.25	64.36	63.26	64.35	63.26
Pant G 186	64.65	63.60	64.66	63.61	64.66	63.61
BG 2083	63.5	62.45	63.51	62.46	63.51	62.46
KKG 306	63.75	62.72	63.75	62.73	63.75	62.73
ICCV 10	65.69	64.64	65.70	64.66	65.70	64.65
L 550	64.85	63.81	64.84	63.80	64.85	63.81
KAK 2	65.32	64.30	65.31	64.29	65.32	64.30
CD at 5%	2.45	2.45	2.48	2.49		

in control, *Rhizobium* inoculated KKG 306 (38.58%) followed by BG 2083 (38.41%) G 2083 (39.06%) in non-reducing sugar, KKG 306 (63.75%) followed by BG 2083 (63.51%) in control, *Rhizobium* inoculated KKG 306 (62.73%) followed by BG 2083 (62.46%) in total sugar. It was revealed from table that reducing sugar, non-reducing sugar and total sugar varied significantly both the year (2010-11 and 2011-12). The results indicate to close favour with Shad *et al.* (2009) and Amir *et al.* (2006).

CONCLUSION

The variations due to genotypes have been screened out by exploring parameters and found suitability of wide uses of desi and kabuli chickpea. It has resulted most promising varieties viz., desi and kabuli *Rhizobium* inoculated genotype PUSA 362, KWR 108 and H 82-2. Among these, PUSA 362was found highest enriching of amino acid content. In regard, desi chickpea varieties also augmented new facts on the nutritional aspect in Pusa 362 and KWR 108. Interestingly Pusa 362 variety encountered rich quantum of carbohydrate sugar and crude fibre thereby, it might be recommended for the users at growing and healthy age group of people.

REFERENCES

Abdalla, A.S., M.E. Abdelgani and A.G. Osman, 2013. Effects of biological and mineral fertilization on yield, chemical composition and physical characteristics of chickpea (*Cicer arietinum* L.) seeds. Pak. J. Nutr., 12: 1-7.

Ali, A., K. Mahmood and M. Afzal, 2003. Cultivation of grain in Thal. Zarantnama, 42: 16-21.

Ali, M. and S. Kumar, 2006. Pulses production in India: Present status and future strategies. Yojana, September Issue, pp: 13-15.

Amir, Y., A.L. Haenni and A. Youyou, 2006. Differences in the biochemical composition of dry legumes cultivated in North Algeria. Electron. J. Environ. Agric. Food Chem., 5: 1411-1418.

CSIR, 1950. The Wealth of India: A Dictionary of Indian raw Materials and Industrial Products. Vol. 11, Council of Scientific and Industrial Research, New Delhi, India, Pages: 154.

Chaterjee, S.P., T.C. Pokhriyal and Y.P. Abrol, 1977. Protein content and amino acid composition of developing seeds of Bengal gram (*Cicer arietinum* L.). Plant Biochem. J., 4: 62-71.

Dubois, M., K.A. Gilles, J.K. Hamilton, P.A. Rebers and F. Smith, 1956. Colorimetric method for determination of sugars and related substances. Anal. Chem., 28: 350-356.

Hart, E.L. and H.J. Fisher, 1971. Modern Food Analysis. Springer, New York, USA., Pages: 519.

Iqbal, A., I.A. Khalil, N. Ateeq and M.S. Khan, 2006. Nutritional quality of important food legumes. Food Chem., 97: 331-335.

Jayraman, J., 1981. Laboratory Manual of Biochemistry. John Wiley and Sons, New Delhi, India, ISBN-13: 9780852264287, Pages: 180.

Kaur, M. and N. Singh, 2007. Characterization of protein isolates from different Indian chickpea (*Cicer arietinum* L.) cultivars. Food Chem., 102: 366-374.

Miller, G.L., 1959. Use of dinitrosalicylic acid reagent for determination of reducing sugar. Anal. Chem., 31: 426-428.

Saxena, B. and R. Saxena, 2011. Nutritional changes in stored chickpea (*Cicer arietinum*) in relation to brunched damage. J. Stored Post Harvest Res., 2: 110-112.

Shad, M.A., H. Pervez, Z.I. Zafar, M. Zia-Ul-Haq and H. Nawaz, 2009. Evaluation of biochemical composition and physicochemical parameters of oil from seeds of desi chickpea varieties cultivated in arid zone of Pakistan. Pak. J. Bot., 41: 655-662.