Int.J.Curr.Microbiol.App.Sci (2020) Special Issue-11: 20-27

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Special Issue-11 pp. 20-27**
Journal homepage: http://www.ijcmas.com

Original Research Article

Physical and Biochemical Studies of Lentil (*Lens culinaris Medik*) Varieties

Atul Prajapati*, R.P. Singh, Brijesh Kumar and R. N. Kewat

Department of Agril. Biochemistry, Acharya Narendra Deva University of Agriculture and Technology Kumarganj, Ayodhya- 224 229 (U.P.) India

**Corresponding author*

Keywords

Number of pods per plant, Test weight, Yield/plant, Seed colour, Total protein content, soluble protein) and Carbohydrate

A B S T R A C T

The present research work entitled Physical and Biochemical studies of lentil (*Lens culinaris Medik*) varieties was conducted during *Rabi* season 2016-17 at the Agronomy research farm and laboratory of Agriculture Biochemistry Narendra Deva University of Agriculture & Technology, Kumarganj Faizabad (UP). was adopted with three replications. Following lentil varieties were grown with proper agronomic practices and the seeds of ten varieties of Lentil namely NDL-1 (C) HUL-57 K-75 DPL-15 NDL-2 IPL-325 VL-148 NDL-22 PL-192 NDL-15 were undertaken to lentil varieties with successive were executed in Completely Randomized Design (CRD) was adopted with three replications. Following lentil varieties were grown with proper agronomic practices and the seeds of ten varieties were collected after harvesting and use for analysis of Physical and biochemical parameters viz., Number of pods per plant, test weight (g), Yield/plant (g) Seed colour Total protein content (%) soluble protein (%) Albumin % Globulin % Methionine (g/16gN) tryptophan content (g/16gN) Lysine content(g/16gN) and Carbohydrate (%). The data obtained in the experiment showed the highest protein content was evaluated in (25.16%) and soluble protein content was recorded in (9.21%) and albumin content was determined in (16.79%) and globulin protein content was evaluated (67.37%) and methionine content was obtained in (1.04 g/16gN) tryptophan content was found in (0.92 g/16gN) Maximum lysine content was recorded in the variety NDL-1 (7.03 g/16gN) maximum carbohydrate content was evaluated in IPL-325 (57.08%) variety.

Introduction

Lentil *(Lens culinaris medic.)* is one of the important and most nutritious *rabi* pulse. It has the potential to cover the risk of rain fed farming. It is also used as a cover crop to check the soil erosion in problem areas. The plants are ploughed back into the soil as green manure also. It derives the name *Lens* from the lens shaped seeds.

Lentil is known for their high nutrient content and health benefits in humans. It is also a great source of carbohydrates and high in fibre and important minerals such as iron and zinc. Lentil also contains essential amino acids isoleucine and lysine, making them a cheap source of protein in developing countries (Callaway *et al.*, 2004). The lentil plant, (*Lens culinaris medik)*, is a member of the Fabaceae (legume) family which is one of the major rabi pulse crop grown in India. To meet the demand for pulses, India has been importing a large quantity of pulses in recent years. In the global context, India is the largest producer of lentil. which is grown

under rain fed and unirrigated conditions, it adds to soil fertility. In India, lentil is mostly grown as a post rainy season crop under receding soil moisture conditions during the winter season. Lentil straw/husk is an important source of feed for animals feeding.

Lentil provides a variety of essential nutrients, containing high levels of protein (20%–30%), minerals (2%–5%), vitamins (folates), and prebiotic carbohydrates. Because of their numerous health benefits, high yield, and nitrogen benefit in food systems, lentil is a useful crop for micronutrient bio fortification efforts. Lentil is considered to be a good source of storage proteins, which are usually consumed by the germ during seed germination. In addition to providing essential and non-essential amino acids and carbon skeletons for the metabolic needs of the human body, lentil is source for some storage proteins that are described as biologically active proteins. Total carbohydrates represent the major component of lentil seeds with starches occupying most of the carbohydrate mass. Furthermore, lentil is a valuable source of total dietary fibres, with insoluble dietary fibre of approximately 93–99.7 %. The total alfa-galactosides or raffinose family oligosaccharides account for 53.0 % of the total sugars and oligosaccharides content in lentils. In these oligosaccharides, stachyose represents the major oligosaccharide, followed by ciceritol and raffinose. The functional significance of these carbohydrates arises from their ability to work as selective promoters for the growth of beneficial gut microbes.

Ryan and colleagues found that lentil seeds contained a total fat of about 1.4 g/100 g, distributed unevenly over the fatty fractions namely: saturated fatty acids (SFA), 16.7 %; monounsaturated fatty acids (MUFA), 23.7 % and polyunsaturated fatty acids (PUFA), 58.8 %. Lentil world production increased from 3.78 million tonnes (Mt) in 2007 to reach 4.4 million tons in 2011, reflecting its nutritional significance. Lentil seeds contain high protein content, and considered the third-highest level of protein of any legume or nut, after soybeans and hemp. Seed protein content ranges from 22% to 34.6%. It also has high levels of carbohydrates (55%–59%) and elevated levels of micronutrients and vitamins.

Lentil contain a number of bioactive substances including enzyme inhibitors, lectins, phytates, oligosaccharides, and phenolic compounds that play metabolic roles in humans or animals that frequently consume these foods. These effects may be regarded as positive, negative, or both (Champ, 2002). Some of these substances have been considered as antinutritional factors due to their effect on diet quality. Enzyme inhibitors and lectins can reduce protein digestibility and nutrient absorption, respectively, but both have little effect after cooking (Lajolo and Genovese, 2002). Phytic acid can diminish mineral bioavailability (Sand berg, 2002).

Materials and Methods

The experiment was conducted during *Rabi* season 2016-17 at the Agronomy Research Farm and laboratory of Agriculture Biochemistry Narendra Deva University of Agriculture & Technology, Kumarganj Faizabad (UP).

The biochemical parameters were as Number of pods per plant Seed weight Colour Yield Protein content in grain was determined by the Lowry's method, (1951). Soluble protein Albumin protein Globulin protein Methionine content was analyzed as described by the Horn *et al.,* (1946). Tryptophan content was estimated by the method of Spies and Chamber (1949). Lysine content was

estimated by the method of Felker *et al.,* (1978) and Carbohydrate content in lentil sample was observed by the method of Yemm and Willis (1954).

Results and Discussions

The number of pods per plant was recorded in the range of 203.00 to 233.67. Toklu *et al.,* (2015) observed that grain yield per plant was significantly correlated with the number of pods per plant, weight of pods per plant, and number of seeds per plant. The number of pods per plant is directly connected to grain yield in lentil and varied from 203 to 233.67. Greater diversity for this trait was observed among advanced lentil lines when compared to the check varieties. Singh *et al.,* (2009) have studied on yield component in large seeded exotic lines of lentil and found sufficient variability regarding number of pods per plants. Kumar and Srivatava (2015) observed on impact of reproductive duration on yield and its component traits in lentil varieties and found number of pods per plant as positive impact on biological yield. Bicer and sakar (2010) studied on the heritability of yield and its component in lentil and found significant difference among genotypes for number of pods per plant. Seed yield was highly correlated with pod yield as reported by Sakar (1998).

Data pertaining to the 1000-seed weight in different lentil varieties was observed between 17.33 and 24.00 (g). Similar range of test weight was also reported by Kumar and Srivastava (2015) while analysing yield component of lentil varieties. Bhartiya *et al.,* (2015) have observed moderate to high variability in majority of quantitative traits including test weight. This indicate that considerable genetic variability exist which has great significance on farming of advance research.The difference in test weight of the variety appeared due to genetic character and other factors such as soil, climate and environment. The variation in the test weight of lentil may be due to heritability and genotypic character of those lentil varieties. It is an indicator of general grain quality and primary grain specification, normally higher the test weight reflects higher quality, and lower the test weight inferior the quality, the grain quality was decreased dramatically as grain deteriorates in long term storage.

Colour of seed in lentil varieties were noticed as brown and pinkish colour by visual observation. The pinkish colour was observed in the lentil variety K-75.The brown colour was visually observed in the varieties NDL-1, PL-192, NDL-2, IPL-325, VL-148, NDL-15, DPL-15, NDL-22, and HUL-57. The colour of seed is one of important factor which determine the presence of pigment, and contributes to product quality in terms of appearance. Variation in the colour within the variety is common, which is evident in lentil varieties. as given by Veena *et al.,* (2005).

The yield per plant was recorded from 4.99 to 8.65 g. The difference in the yield per plant in different lentil variety may be due to genetic character and other factors such as soil, climate and environment. Similar yield per plant also reported by Toklu *et al.,* (2015) who also found that biological yield is an important plant characteristic used in breeding programs for selection.

The protein content was recorded between 21.94 to 25.16 percent. Protein performs variety of function in living organism including metabolic reactions and DNA replication. Variation in the protein content in lentil varieties may be due to genetic diversity and environmental variation. Protein differ from one another primarily by their sequence of amino acids which is detected by the amino nucleotide sequence of their genes and which usually result in protein folding

into specific three-dimensional structure which determine their activity. Albumin and globulin seed storage proteins are important as they participate in creating several enzymes. The other reason for the differences in the proteins content of lentil varieties may be due to their amino acid composition as reported by Alalshoimy *et al.,* (2007). Boyle *et al.,* (2010) observed protein content in green lentil and red lentil was 23.0 percent and 25.8 percent, respectively. Suleiman *et al.,* (2008) observed that the total protein of lentil was fractionated on the basis of solubility for albumin, globulin prolamin and glutelin. Singh *et al.,* (2014) observed that most of the lentil proteins are storage proteins which are usually consumed by the germ during seed germination. Qayyum *et al.,* (2012) also found similar range of protein in lentil. Moldovan *et al.,* (2015) also observed similar range of protein content and also found that green lentil has high protein content as compared to red lentil.

Soluble proteins are those proteins which are soluble in water. Albumin in also soluble in water while globulin is soluble in various salt solutions. The soluble protein, albumin and globulin content of chickpea seeds were studied by Mittal and Koundal (1990) and found that seed development is essentially completed at 42 days after flowering. The soluble protein and albumin were found higher during early stages of seed development. Globulin was synthesized actively between 20 days after flowering till 36 days after flowering Mittal and Koundal (1990).The soluble protein observed between 7.09 to 9.21percent. The highest soluble protein content was recorded in NDL-1 (9.21%) followed by K-75 (9.16%), HUL-57 (9.020%) and NDL-15 (8.78%). The lowest soluble protein in was obtained in IPL-325 (7.09%) variety. Soluble proteins are physiologically active protein and they constitute major bulk of enzyme. Most enzymatic proteins are water soluble i.e. Albumin type so, decrease in the amount of these protein could be due to their active participation in seed development process. High percentage of albumin in soluble protein is also reported in pea by Beever and Bulson (1972).

The albumin content was recorded in the range of 14.25 to 16.79 percent. Similar albumin protein content also reported by Parra (2018), they also reported that albumin is soluble in water while glutelins are soluble in dilute acid and base solution and constitute as a part of defence mechanism of the seeds. Mainly enzyme inhibitor such as anti trypsin of lentil has been associated with cholesterol and lipid lowering effects in humans, along with reducing the incidence of colon cancer and type-2 diabetes (Roy *et al*., 2010).

The globulin synthesis starts slowly up to 20 days and the rate of synthesis increased between 20 to 40 days. Period till 20 days represent first phase of seed development in which mainly cell division occurs in the embryo but very little synthesis of storage protein reserve occurs. Active synthesis of globulin protein occurs after 20 days till 40 days and increase in size of cotyledon by cell expansion. In the latter part of second phase, there is decrease in synthetic activity. Similar pattern of development was also observed in pea as reported by Gatehouse *et al.,* (1984) and vicea faba by Baily and Boulter (1972). Maximum rate of synthesis occurs between 20 and 40 days and these stages are appropriate for the extraction of mRNA specific for globulin. Alalshoimy (2007) studied the isolation and partial characterization of chickpea, lupine and lentil seed protein. All the studied showed higher proteins solubility at alkaline pH as a result of their high content of acidic amino acids. The ammonium sulphate is found for precipitating the major protein content, which

reduced the availability of water to minimum level and hence pushing protein molecules precipitated by interacting with each other. Hung *et al* (2008) have also studied on extraction and characterization of chickpea albumin and globulin fraction. They have noticed that albumin could be extracted as major fraction of chickpea proteins. Higher level of essential amino acid and sulphur containing amino acids were found in albumin fraction than globulin of all chickpea investigated. The globulin protein content was observed between 64.21 to 67.37 percent. The maximum globulin protein content was obtained in NDL-1 (67.37%) variety followed by K-75 (66.04%), HUL-57 (65.92%) and NDL-15 (65.81%) in present research work.

Methionine is a sulphur containing amino acid which is involved in number of biochemical reactions especially transmethylation reaction of vital significance in the biological system. Methionine is a proteinogen amino acid, when it is present in natural L- form. It is an essential amino acid cannot be synthesized by the body itself. The amount of methionine variation among the varieties may be due to their genetical character. The methionine content was recorded in the range of 0.51 to 1.04 g/16gN. Variation in methionine content may be due to difference in genetic potential and protein content of lentil varieties. Ziaulhaq *et al.*, (2011) observed the amino acid composition in four lentil cultivars indicated a little variation in essential and non-essential amino acid, however significant variation was recorded in isoleucine, methionine and tryptophan content.

Tryptophan amino acid has got a fundamental role in the biosynthesis of nicotinamide vitamin (B_6) as well as other metabolic process. It is a hydrophobic amino acid and act as essential non-polar, aromatic amino acid. It contains alpha-amino group, an alpha-carboxylic group, and a side chain indols. Tryptophan is also a precursor to neurotransmitters serotonin and melatonin. The tryptophan content was observed between 0.49 and 0.92(g/16gN) in lentil varieties (Table 1–3).

Table.1 Number of pods per plant, test weight (g), Yield/plant (g) and Seed colour of lentil varieties

S. No.	Varieties	Number of pods / plant	1000- seed weight (g)	Yield/plant (g)	Seed colour
1.	NDL-1 (C)	233.67	18.67	8.65	Brown
2.	HUL-57	229.00	20.33	7.19	Brown
3.	K-75	207.00	24.00	5.89	Pinkish
4.	DPL-15	219.00	19.67	8.54	Brown
5.	NDL-2	203.33	17.33	7.20	Brown
6.	IPL-325	227.33	21.00	8.64	Brown
7.	VL-148	204.00	18.00	7.80	Brown
8.	NDL-22	206.00	18.00	7.02	Brown
9.	PL-192	203.00	20.00	4.99	Brown
10.	NDL-15	226.00	19.00	6.31	Brown
	SEM ±	2.015	0.678	0.6131	
	CD at 5%	5.85	1.968	1.779	

Table.2 Total protein content (%) soluble protein (%) Albumin % and Globulin % of lentil varieties

S. No.	Varieties	Total protein %	Soluble protein %	Albumin %	Globulin %
1.	NDL-1 (C)	25.16	9.21	16.79	67.37
2.	HUL-57	24.63	9.02	16.26	65.92
3.	K-75	24.98	9.16	16.48	66.04
4.	DPL-15	23.46	8.24	15.86	65.56
5.	NDL-2	22.16	7.56	15.27	64.82
6.	IPL-325	21.94	7.09	14.25	64.21
7.	VL-148	22.71	7.61	15.43	65.17
8.	NDL-22	23.07	8.01	15.61	65.37
9.	PL-192	22.01	7.25	14.72	64.43
10.	NDL-15	24.18	8.78	16.11	65.81
	SEM ±	0.048	0.077	0.037	0.012
	CD at 5%	0.14	0.22	0.11	0.03

Table.3 Methionine (g/16gN) tryptophan content (g/16gN) Lysine content (g/16gN) and carbohydrate (%) of lentil varieties

S. No.	Varieties	Methionine content (g/16gN)	Tryptophan content (g/16gN)	Lysine content(g/16gN)	Carbohydrate (%)
1.	NDL-1 (C)	1.04	0.92	7.03	51.28
2.	HUL-57	0.91	0.77	6.71	53.66
3.	K-75	0.98	0.84	6.89	52.19
4.	DPL-15	0.79	0.64	6.48	54.73
5.	NDL-2	0.63	0.53	5.91	56.12
6.	IPL-325	0.51	0.49	5.32	57.08
7.	VL-148	0.68	0.57	6.07	55.81
8.	NDL-22	0.72	0.61	6.21	55.36
9.	PL-192	0.56	0.51	5.74	56.54
10.	NDL-15	0.84	0.70	6.59	54.14
	SEM ±	0.0071	0.0095	0.01892	0.0332
	CD at 5%	0.02	0.028	0.05	0.097

Lysine is an essential amino acid having a positive charged α– amino group and basic in nature. Lysine is basically an alanine with a prolamine substituents on the β-carbon. The alpha-amino group has significantly higher key role than the amino group. The lysine content was recorded in the range of 5.32 to 7.03 (g/16gN). The results are in agreement to (www.google.com). Variation in lysine content may be due to difference in genetic potential and protein content of lentil varieties.

The carbohydrate content was observed in the range of 51.28 to 57.08 percent. Carbohydrates are hydrates of carbon and act as precursor for many organic components such as fats, amino acid. Carbohydrate in the form of glycoprotein and glycolipids participate in the structure of cell membrane and cellular function. Difference in the carbohydrate content may be due to genetic and environmental condition in present investigation. Carbohydrate can function as long term food storage molecules, as protective membranes for organisms and cells, and as the main structural support for plant and constituents of many cells and their content. Pulse carbohydrates were rich in glucose, arabinose, galactose and uronic acids. Stachyose, a fermentable fibre, was the most abundant oligosaccharide, making up 1.5%–2.4% of the dried pulse powders as given by Cheswarth *et al* (2005). In pulses, glucose derived from starch and cellulose which makeup the largest part of carbohydrate. The rhamnose, arabinose, galactose and uronic acids are derived mainly from the pectins which were about 9.3 % in lentil crop as suggested by Tosh *et al* (2013).

On the basis of overall observations, it can be concluded that maximum number of pods and yield per plant were recorded in NDL-1 while test weight was observed highest in K-57. Highest protein content (25.16%), Soluble protein content (9.21%), Albumin content (16.79%), Globulin content (67.37%), Methionine content (1.04 g/16gN), Tryptophan content (0.92 g/16gN) and Lysine content (7.03 g/16gN), content were noticed in NDL-1.

References

Alalsohoimy, S.A.; Sitohy; M.Z and El-Masry, R.A. (2007). Isolation and partial characterization of chickpea, lupine and lentil seed proteins. *World Jour. of Agric. Sci.*, 3(1):123-129.

Beevers, L and Bulson, R. (1972). Protein synthesis in cotyledons of *Pisum sativum* L. plant physiol, 49:476.

Bhartiy, A; Aditya, J. P and Singh, S. (2015). Assessment of variability for agro-morphological traits in elite lentil (*Lens culinaris Medik*) lines using multivariate analysis. *Indian J. Agric. Res.*, 49 (6):539-543.

Bicer, B; Tuba and D, Sakar. (2010). Heritability of yield and its components in lentil (*Lens culinaris* Medik.). *Bulg. J. Agric. Sci.*, 16: 30-35

Boyle, J. L; S. Aksay, S; Roufik, S; Ribereau, M; Mondor, M; Mondor, E; Farnworth and S.H. Rajamohamed. (2010). Comparison of the functional properties of pea, chickpea and lentil protein concentrates processed using ultrafiltration and isoelectric precipitation techniques. *Food Res. Int.*, 43: 537-546.

Callaway, J. C. (2004). Hempseed as a nutritional resource: An overview. Euphytica 140. 65-72.

Champ, M. M. (2002). Non-nutrient bioactive substances of pulses. *British Journal of Nutrition, 88(Suppl. 3)*, S307–S319.

Cheswarth, J.M; Stuchburry, T and Scaife, J.R. (2005). *In: an introduction to Agriculture Biochemistry, Chapman and hall Publ.* P-67.

Felker, C; Libamuskas, C. K and Warner, G. (1978). *Crop. Sci*, 18(3): 489-490.

Horn, J. M; Jones, J. B and Blum, A.E. (1946). Colorimetric determination of methionine in protein and foods. *J. Bio. Chem.*, 1 (16): 313.

Lajolo, F. M and Genovese, M. I. (2002). Nutritional significance of lectin and enzyme inhibitors from legumes. *Journal of Agricultural and Food Chemistry*, 50, 6592–6598.

Lowry, O. H; Rosebrough, N. J; Farr, A. L and Randal, R. J. (1951). Protein measurement with the follin phenol reagent. *Journal Biochemistry,* 193: 265-275.

Mittal, M and Koundal, K.R. (1990). Isolation and characterization of storage proteins of developing seeds of chickpea. *Int. J. Agril. Biochem,* 3 (142):1-10.

Moldovan, O; Paucean, A; Vlaic, R; Bors, D.M and Muste, S. (2015). Preliminary assessment of the nutritional quality of two types of lentils *(Lens culinaris Medik)* by Near Infrared Reflectance Spectroscopy Technology (NIRS). *Bulletin Uasvam Food Science and Technology* 72(1).

Qayyum, N.M.M., Butt, S.M., Anjum, M.F. and Nawaz, H. (2012). Composition analysis of some selected legumes for protein isolates recovery. *The journal of animal & plant sciences*, 22(4): 1156-1162.

Singh, K.A., Kumar, P., Singh, J., Rani, R., Rani, A., Shukla, P. and Misra, P. (2014). Biochemical profiling of lentil (*lens culinaris*medik) germplasm at different growth stages. *J. Biol. Eng. Res. & Rev* 2 (1) 01-06.

Singh, S; Singh, I; Gill, K.R; Kumar, S and Sarker, A. (2009). Genetics studies for yield and component characters in large seeded exotic lines of lentil. *Journal of food legumes* 22(4): 229-232.

Toklu, F., Ozkan, H., Karakoy, T. and Coyne, J.C. (2015). Evaluation of advanced lentil lines for diversity in seed mineral concentration, grain yield and yield components. *Journal of Agricultural Sciences Journal homepage: www.agri.ankara.edu. tr/journal.*

Tosh, M.S., Farnworth, R.E., Brummer, Y., Duncan, M.A., Wright, J.A., Boye, I.J., Marcotte, M. and Benali, M. (2013). Nutritional profile and carbohydrate characterization of spray-dried lentil, pea and chickpea ingredients. *Foods* 2, 338-349.

Veena, B and Desikachar, H. S. R. (2005). Milling popping and malting characteristics of some minor millets. *J. Food Sci. and Tech.* 22:400-403.

Yemme, E. W and Wills, A. J. (1954). The estimation of carbohydrate in plant extracted by Anthrone Biochemical. *Journal Biochemistry,* 87: 508-514.