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PROTEIN AND MINERAL CONTENTS OF PEA (*Pisum sativum* L.) GENOTYPES GROWN IN CENTRAL ANATOLIAN REGION OF TURKEY

Mustafa HARMANKAYA[1], Mehmet Musa ÖZCAN[2*], Serdar KARADAŞ[3] and Ercan CEYHAN[3]

1. University of Selcuk, Agriculture Faculty, Department of Soil Science and Plant Nutrition, 42075 Konya, Turkey.
2. University of Selcuk, Agriculture Faculty, Department of Food Engineering, 42075 Konya,Turkey.
3. University of Selcuk, Agriculture Faculty, Department of Field Crops, 42075 Konya, Turkey.
*Corresponding address: M.M. Özcan, E-mail: mozcan@selcuk.edu.tr

Abstract: *This study investigated differences in protein and mineral contents in grains of nineteen pea (Pisum sativum L.) cultivars. Statistically significant variations were found amongst the genotypes for all variables. The protein and minerals analyzed for all pea genotypes show that protein varies from 21.13 to 27.05, potassium from 562.8 to 937.8 mg/ 100 g, phosphorus from 163.4 to 374.2 mg/100 g, calcium from 45.91 to 157.40 mg/100 g, magnesium from 47.31 to 102.81 mg/100 g, sulfur from 75.69 to 194.4 mg/100 g, iron from 2.19 to 5.84 mg/100 g and zinc from 2.10 to 5.71 mg/100 g. Negative and significant relationships were found statically between protein content and potassium (K), between protein content and sulfur (S), and between protein content and zinc (Zn).*

Key words: *pea, protein, mineral contents.*

INTRODUCTION

Pulses are rich, not only in protein and starch, but also in other nutrients such as fibre, vitamins and minerals, which are well suited to meet the demands of health conscious consumers. Pulses have shown many health benefits such as lower glycemic index for persons with diabetes and cancer prevention (Viswanathan et al. 1989, Hangen & Bennink 2002). Pea is an annual self-pollinated species, and highly valued food legume grown extensively in the world. It is a good source of protein and plays an important role in human nutrition since they are a rich source of protein,

calories, certain minerals and vitamins. In Turkey, the pea is considered to be a healthy vegetarian food and it is one of the most important human nutrition. It is a cheap source of high quality protein in the diets of millions in Turkey, who cannot suffer animal protein from balanced nutrition. In addition to protein, it is a good source of trace elements and carbohydrates (Akcin 1988). Proteins are major components of grain legumes, and their nutritional and functional properties dramatically affect the overall quality of seed (Duranti & Gius 1997). Growing a variety rich in protein content will also require consideration of some minerals elements of the grain.

The aim of this study was to investigate the protein and chemical composition and to define the relationship between the protein content and mineral properties of some pea genotypes grown in Turkey. The results obtained should permit us to select and identify the best rich nutrients of pea genotypes. It would also give base genotype information to ongoing research work on mineral elements and protein content of pea genotypes grown in Turkey.

MATERIAL AND METHOD

Materials

The pea genotypes used in this research were improved from a cross made between Sprinter, Manuell, Carina and Bolero. PS4009, PS4023, PS3065, PS3057, PS4021, PS4053-1, PS4028, PS30100, PS3045, PS3048, PS3053, PS3012, PS3055, PS3029-1, PS3037, PS3029-2 and PS4053-2 are improved grow by Dr. Ercan CEYHAN. These genotypes were grown at the Prof. Dr. Abdulkadir AKCİN Research Farm of the Selcuk University in Turkey (in 2006) Genotypes were sown in March 2006 and harvested in July of the same year. Samples were collected after harvesting mature whole raw peas.

Methods

Sample preparation

After harvest, pea genotypes samples were prepared for each plot. The seeds were cleaned manually to remove all foreign matter such as dust, stones and chaff as well as immature, broken seeds. Before analysis, initial moisture content of pea genotypes were determined by using a drying cabinet with air-circulation at 70±1 ^{o}C for 48 h on a 50 g pea sample (Bayraklı 1987).

Protein content

Protein content was determined using the LECO TruSpec CN (Carbon/Nitrogen) (LECO Corporation, St. Joseph, MI). 0.2 g sample was placed in the sample holder and analyzed. The nitrogen content estimated by the Kjeldahl method and was converted to protein content by using the conversion factor 6.25 (A.O.A.C, 1984).

Mineral content

About 0.5 g dried and ground sample was digested by using 5ml of 65% HNO_3 and 2 ml of 35% H_2O_2 in a closed microwave system (Cem-MARS Xpress). The volumes of the digested samples were completed to 20 ml with ultra-deionized water and mineral concentrations were determined by inductively coupled plasma-optical emission spectroscopy (ICP OES; Perkin-Elmer, Optima DV 2000). Measurements of mineral concentrations were checked using the certified values of the related minerals in the reference samples received from the National Institute of Standards and Technology (NIST; Gaithersburg, MD, USA). These values were expressed as mg/ 100 g dry matter (Skujins 1998). All data were subjected to a randomized complete blocks model of ANOVA, and F-test applied to examine the statistical significance of differences amongst the varieties. Experimental data were analyzed by using TARIST.

RESULTS AND DISCUSSION

The results for protein content and mineral composition of pea are summarized in Table 1. There were significant differences in these values among the nineteen cultivars of pea. The protein content for the nineteen pea genotypes ranged from 21.13 % to 27.05 %, with a mean of 23.89 %, and these values are in close agreement with the results reported by other researchers (Wang & Daun 2004, Yoshida et al. 2007). These differences in protein content were due to a combination of genetic and environmental factors. For all genotypes, significant differences were observed in the mineral contents (Table 1). Potassium (K) was the most abundant element, varied from 562.8 (PS3065) to 937.8 mg/ 100 g (PS3053) (Table 1). Phosphor (P) was found to range from 163.4 (PS3065) to 374.2 mg/ 100 g (PS3029-1). All pea genotypes contained a higher amount of potassium and phosphorus than other minerals present. The mineral contents were in the range reported by Wang & Daun (2004) for pea. Calcium (Ca) ranged from 45.91 (PS3065) to 157.4 mg/ 100 g (PS3057), and magnesium (Mg) ranged from 47.31 (PS3065) to 102.8 mg/ 100 g (PS3012). Sulfur (S) varied from75.69 (PS3065) to 194.4 mg/ 100 g (PS3053), iron (Fe) from 2.19 (PS30100) to 5.84 mg/ 100 g (PS4053-1) and zinc (Zn) from 2.10 (PS3065) to 5.71 mg/ 100 g (PS3029-2) (Table 1). Such variations in the content of minerals for pea samples might be due to their genetic origin. Results obtained in this study were also comparable with those reported for other pulses (Wang & Daun 2004, Yoshida et al. 2007, Ceyhan et al. 2008, Harmankaya et al. 2009).

Positive and significant relationships were determined statistically between calcium (Ca) and potassium content, between iron (Fe) and

Table 1.

Crude protein and mineral contents of pea genotypes with respect to variables analyzed.

	Crude protein (%)	Calcium (mg /100 g)	Iron (mg/ 100 g)	Potassium (mg /100 g)	Magnesium (mg /100 g)	Phosphorus (mg/ 100 g)	Sulfur (mg/ 100 g)	Zinc (mg /100 g)
Sprinter	23.98 e	91.81 f	4.31 bc	666.0 o	78.89 k	263.2 n	147.8 ı	4.31 e
Manuell	23.26 f	102.6 d	4.47 b	715.3 m	80.67 h	311.1 h	139.4 l	2.42 l
PS4009	24.70 d	73.45 k	3.61 ef	613.6 p	74.76 l	238.3 p	120.1 p	3.67 ghı
PS4023	24.04 e	62.82 m	3.42 fgh	736.4 k	74.74 l	288.5 k	133.5 n	3.17 j
PS3065	25.31 c	45.91 r	2.42 j	562.8 q	47.31 m	163.4 q	75.69 r	2.10 m
PS3057	25.19 c	157.4 a	3.75 de	767.5 ı	89.13 d	367.5 c	155.4 g	3.84 fgh
PS4021	24.08 e	78.20 j	3.38 gh	791.8 f	89.55 d	322.1 e	151.4 h	3.53 ı
PS4053-1	24.32 de	50.14 q	5.84 a	746.3 j	89.57 d	338.7 d	141.6 k	3.23 j
PS4028	26.33 b	73.76 k	3.75 de	814.7 e	89.56 d	367.7 c	150.9 h	3.85 fg
PS30100	25.43 c	51.12 p	2.19 j	673.2 n	81.34 g	269.6 m	127.1 o	2.79 k
PS3045	27.05 a	84.11 ı	4.20 c	731.3 l	86.39 f	312.1 g	145.1 j	3.90 f
PS3048	23.37 f	54.88 o	4.41 bc	665.1 o	79.46 j	255.6 o	114.9 q	3.66 hı
PS3053	23.40 f	100.1 e	3.60 efg	937.8 a	98.33 b	373.3 b	194.4 a	4.64 cd
PS3012	21.82 h	120.3 c	4.21 c	775.6 h	102.8 a	314.1 f	163.3 d	5.41 b
PS3055	21.13 ı	65.68 l	2.88 ı	824.5 d	90.38 c	322.6 e	173.4 b	4.61 cd
PS3029-1	21.34 ı	122.9 b	3.31 h	869.5 b	89.49 d	374.2 a	162.1 e	4.71 c
PS3037	22.26 gh	55.81 n	3.21 h	854.7 c	80.02 ı	273.5 l	135.6 m	4.50 d
PS3029-2	22.54 g	87.50 h	4.38 bc	786.0 g	88.48 e	297.2 j	161.4 f	5.71 a
PS4053-2	24.33 de	89.62 g	3.86 d	868.7 b	86.21 f	303.3 ı	165.4 c	5.40 b
Mean	**23.89**	**82.53**	**3.75**	**757.94**	**84.06**	**302.9**	**145.2**	**3.97**
LSD	0.4441	0.3716	0.2329	1.812	0.5573	0.7161	0.5999	0.1858

Table 2.

Correlations coefficients between protein content and minerals in pea genotypes.

Variable	Crude Protein (%)	Calcium (mg /100 g)	Iron (mg/ 100 g)	Potassium (mg /100 g)	Magnesium (mg /100 g)	Phosphorus (mg/ 100 g)	Sulfur (mg/ 100 g)	Zinc (mg /100 g)
Protein Content	------							
Calcium Content	-0.171	------						
Iron Content	-0.001	0.164	------					
Potassium Content	-0.408**	0.369**	0.056	------				
Magnesium Content	0.167	-0.072	0.049	0.336**	------			
Phosphorus Content	-0.154	0.583**	0.299*	0.783**	0.386**	------		
Sulfur Content	-0.378**	0.552**	0.216	0.853**	0.280*	0.826**	------	
Zinc Content	-0.479**	0.403**	0.187	0.644**	-0.039	0.391**	0.714**	------

* and ** statistically significant at 0.05 and 0.01 probability levels, respectively

phosphorus (P), between potassium (K) and magnesium (Mg), between magnesium (Mg) and phosphorus (P), between magnesium (Mg) and sulfur (S) and between sulfur (S) and zinc (Zn) (Table 2). The results are consistent with the finding of Ceyhan et al. (2008) and Harmankaya et al. (2009), who found similar interrelations in bean. Negative and significant relationships were found statistically between protein content and potassium (K), between protein content and sulfur (S), and between protein content and zinc (Zn) (Table 2).

CONCLUSIONS

The results of this study shown that some pea genotypes presented higher protein, potassium, phosphorus, calcium, magnesium, sulfur, iron and zinc contents than cultivated varieties. Significant differences in protein content, potassium, phosphorus, calcium, magnesium, sulfur, iron and zinc content were found among varieties. PS3045, PS3057, PS4028 and PS4053-1 presented higher protein, potassium, phosphorus and magnesium contents than those of all varieties. Peas were a good source of minerals such as calcium, iron, potassium, magnesium, phosphorus and zinc. The lower cost of the legumes, the reduced incomes of the majority of people of Turkey, together with the high prices of animal products, may justify these efforts. This may be of potential importance for growing studies in selecting for improved legumes with high protein and mineral content. These results revealed that pea may provide a sufficient amount of minerals to meet the human mineral requirement.

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REFERENCES

Akcin, A. (1988): Yemeklik Tane Baklagiller. Selcuk University Faculty of Agriculture Konya, Publication No. 8: 41-189.

Bayraklı, F. (1987): Toprak ve Bitki Analizleri (Soil and Plant Analayses). 19 Mayıs University Agriculture Faculty, Publication No.17, Samsun.

Ceyhan E., Harmankaya, M., Avcı, M.A. (2008): Effects of Sowing Dates and Cultivars on Protein and Mineral Contents of Bean (Phaseolus vulgaris L.). Asian Journal of Chemistry 20(7): 5601-5613.

Duranti, M., Gius, C. (1997): Legume Seeds. Protein Content and Nutritional Value. Field Crops Research 53: 31-45.

Hangen, L., Bennink, M.R. (2002): Consumption of Black Beans And Navy Beans (Phaseolus vulgaris) Reduced Azoxymethane-Induced Colon Cancer in Rats. Nutrition and Cancer 44(1): 60–65.

Harmankaya, M., Karadaş, S., Palta Ç., Ceyhan E. (2009): Relationships Between Protein Content and Chemical Compositions of Local Dry Bean (Phaseolus vulgaris L.) Genotypes Grown in Turkey. Asian Journal of Chemistry 21(2):1535-1540.

Skujins, J. (1998): Handbook for ICP-AES(Varian-Vista). A short Guide to Vista Series ICP-AES Operation. Varian Int. AG, Zug,Version 1-0, Switzerland.

Viswanathan, M., Ramachandran, A., Indira, P., Snehalatha, C., Mohan, V., Kymal, P.K. (1989): Responses to Legumes in NIDDM Subjects-Lower Plasma-Glucose and Higher Insulin Levels. Nutrition Reports International 40: 803–812.

Yoshida, H., Tomiyama, Y., Tanaka M., Mizushina Y. (2007): Characteristic profiles of lipid classes, fatty acids and triacylglycerol molecular species of peas (Pisum sativum L.). European Journal of Lipid Science and Technology 109: 600–607.

Wang, N., Daun, J.K. (2004): Effect of variety and crude protein content on nutrients and certain antinutrients in field peas (Pisum sativum). Journal of the Science of Food and Agriculture 84: 1021–1029.

*** A.O.A.C. (1984). Official Methods of Analysis. Association of Official Chemistry. 14th ed, Association of Official Analytical Chemists., Arlington. VA.