Journal of Kerbala for Agricultural Sciences Issue (4),Volum (6), (2019)

Estimation of some qualitative traits in dry seed pea (*Pisum sativum*) cultivars compare to local wild in Sulaimani region

Bestoon Ali Abdolla — **Assistant Lecturer**
Sherwan Ismail Tofiq — **Professor**
Department of Biotechnology and Crop Sciences , College of Agricultural Engineering Sciences, University of Sulaimani
Corresponding author: bestoon.abdolla@univsul.edu.iq

Abstract:

The present study was conducted in the Sulaimani region. The cultivars were seeded at Nov 15th 2018 and they were harvested on June 3rd 2019. The chemical analysis was carried out on June 22th 2019, to estimate some chemical components of four peas cultivars (American,Avola, pakland and Jeza with Local wild) according to a Completely Randomized Design (CRD), replicated three times. Means comparison was carried out using the Least Significant Difference test (LSD) at 0.01 significant levels. The results of this study summarized as follow:

There were highly significant differences among cultivars for all chemical components, exception of P%, which was only significant. The Jeza cultivar produced the highest percentage of fiber, oil, and moisture reached 4.27, 3.13, and 11.71% respectively, while the Pakland cultivar showed the highest percentage of K and Mg reached 1.22 and 0.15%, respectively. The highest value of most chemical components, including protein, ash, starch, total N, Ca, and P% produced by local wild reached 26.63, 6.83, 42.71, 4.27, 0.31 and 0.15%, respectively . The protein % correlated high significantly and positively with ash, starch and P% ($r = 0.927, 0.958$ and 0.789, $p < 0.01$) respectively, while it correlated high significantly and negatively with fiber% ($r =- 0.813$, $p < 0.01$), and also there are significant and negative correlation between protein and moisture ($r = - 0.745$, $p < 0.01$)

Key word: Pea varieties, Chemical components, Chemical elements, Correlation.

تقدير بعض الصفات النوعية في البذور الجافة لبعض اصناف البازلاء (*Pisum sativum*) بالمقارنة مع النوع البري المحلي في المنطقة السليمانية

بيستون على عبدالله — **مدرس مساعد**
شيروان اسماعيل توفيق — **أستاذ**
كلية العلوم الهندسة الزراعية، قسم التقنيات الحياتية و علوم المحاصيل ، جامعة السليمانية
البريد الأكتروني : bestoon.abdolla@univsul.edu.iq

المستخلص:

اجريت هذه الدراسة في محافظة السليمانية ,تم زراعة الأصناف خلال 15 نوفمبر 2018 وتم حصادها في 3 يونيو 2019. وقد إجريت التحليل الكيميائي في 22 يونيو 2019 ، لتقدير بعض المكونات الكيميائية لأربعة اصناف من البازلاء (Americana, Avola, Pakland and Jeza مع نوع بري Local wild) وفقا

لتصميم العشوائي الكامل CRD وبثلاث مكررات. اجريت المقارنة بين المتوسطات للأصناف حسب اختبار اقل فرق معنوي LSD و تحت مستوى المعنوية (0.01) . واظهرت نتائج التحاليل الكيميائية هناك فروقات عالية المعنوية بين الأصناف لجميع التحاليل الكيميائية بأستثناء النسبة المئوية للفسفور حيث تكون الفروقات بين الأصناف معنوي فقط. وجد بأن الصنف Jeza سجل اعلى نسبة مئوية للألياف، الزيت و الرطوبة وصلت الى 4.27، 3.13 و 11.71% بالتتابع، بينما انتج الصنف Pakland اعلى نسبة المئوية للعناصر K و Mg وصلت الى 1.22، 0.15% بالتتابع. انتج النوع البري المحلي اعلى نسبة لمعظم المركبات الكيميائية و منها البروتين، رماد، النشاء، النايتروجين الكلي، الكالسيوم و الفوسفور تصل الى 26.63، 6.83، 42.71، 4.27، 0.31 و 0.15% بالتتابع. هنالك ارتباط موجب و عالي المعنوية بين البروتين مع الرماد،النشاء و الفوسفور($p < 0.01$ ،0.789 و $r= 0.927, 0.958$) بالتتابع، بينما هنالك ارتباط سالب و عالي المعنوية بين البروتين و الألياف ($r= -0.813$، $p < 0.01$)، كما وهناك ارتباط معنوي وسالب بين البروتين و الرطوبة ($r= -0.745$، $p < 0.01$).
كلمات المفتاحية: اصناف البازلاء، المركبات الكيميائية، عناصر الكيميائية، الأرتباط

Introduction

Pea (*Pisum sativum* L.) a legume, and a member of the Leguminoseae family is a native of central or Southeast Asia (Warren et al., 1956*)*. The pea is full of nutrition because its grain is rich in protein (27.8%), complex carbohydrates (42.65%), vitamins, minerals, dietary fibers, and antioxidant compounds (Urbano et al., 2003). Good management practices are essential if optimum fertilizer responses are to be realized. These practices include use of recommended pea varieties, good seed bed preparation, proper seeding methods, effective plant insect control. Soil test results, field experience, and knowledge of specific crop requirements help to determine the nutrients needed and the rate of application (Hadavizadeh., 1989). Seed quality can be increased by careful management of seed crops during production in the field, harvest, post-harvest, processing, and storage. Although the nutritional value of peas is lower than that of a good quality soybean meal, this legume is an important source of supplemental protein in animal diets of protein in peas that been widely reported in the literature (Marquardt et al., 1975) and (Thacker & Bowland., 1985). The toxic compounds present in peas that adversely affect the availability and utilization of nutrients are also well characterized (Griffiths, 1983) and (Savage, 1989). Chickpea and field pea has a relatively short growing season and uses less water than many other broadleaf crops such as sunflower or safflower (Johnson et al., 2002). Grain legume crops are important source of protein, energy, vitamins, and minerals and are a truly significant factor in the nutrition of ruminants and monogastric livestock. Worldwide the forage pea (*Pisum sativum* L.) is among the four most important annual legume crops together with soybean, peanut, and haricot bean (Hulse., 1994) (Bansal et al., 2011). The quantity and the quality of the protein in the seeds are important parameters for the evaluation of the feeding value of forage pea. Legume crop investigations show that protein content is characterized by a high degree of inheritance, which is a good possibility for the selection of high protein forms. Plant cell walls fiber components also determine the digestibility of forage dry matter (Brink et al., 2007) and (Fahey & Hussein, 1999).

The objective of this investigation was to provide a detailed chemical composition of introduced pea cultivars and compared with local wild pea cultivar in a semi-arid region.

Materials and methods:

A comparative study of some qualitative traits was carried out for some pea cultivars at Qliasan research station – college of agricultural science/university of Sulaimani during june 22th 2019. Four promising cultivars (Americana, Pakland, Avola and Jeza, with Local wild) were used. The seeds were obtained from the previous study conducted in Qliasan research station during winter season 2018-2019, and then three samples of seeds for each cultivar were randomly taken for chemical analysis which was conducted according to CRD a Completely Randomized Design repeated three times. All possible comparisons among the means were carried out by using the L.S.D test (Least Significant Difference) at a significant level of 1% after they show their significance in the general test (Abdulkhaleq., 2006).

The following quality parameters were determined by (Near-infrared/NIR spectroscopy Lab Analysis) and (Inductively coupled plasma atomic emission spectroscopy ICP-AES). Study characters:

1- Protein %
2- Starch %
3- Oil %
4- Fiber %
5- Moisture %
6- Ash %
7- Total Nitrogen %
8- Calcium %
9- Potassium %
10- Magnesium %
11- Phosphorus %

Correlation Coefficient among the Characteristics:

It was estimated depending on the traits mean of the genotypes as follows (Singh & Chaudhary., 1979):

$$r = \frac{\sum XY - \frac{(\sum X)(\sum Y)}{n}}{\sqrt{[\sum X^2 - \frac{(\sum X)^2}{n}]\,[\sum Y^2 - \frac{(\sum Y)^2}{n}]}}$$

$$t_{(r)Cal.} = \frac{r}{\sqrt{1-r^2/n-2}}$$

Where: n: Number of the treatments,
r: Correlation coefficient.

The significance of r value tested according to the t-test at n-2 degree of freedom.

Result and discussion:

Data represent in table 1 illustrate the mean squares of analysis of variance of some chemical compositions for pea cultivars. It was observed that the mean squares of cultivars were highly significant for all chemical compositions, which indicated the high variability among the cultivars. It can be concluded that the studied cultivars varied in chemical composition, metabolizable energy content, and bioavailability (Igbasan etal., 1997).

(Ravindran et al., 2010) did not find significant differences in the crude nutrients and amino acid (AA) contents between five pea cultivars cultivated in New Zealand. (Canbolat et al., 2007) examined only slight but significant differences of the contents of crude protein, crude ash, and crude fiber between white- and purple-flowered peas from two consecutive harvest years in Turkey.

Table 1: Mean squares of some chemical component of pea varieties.

S.O.V	d.f	M.S					
		Protein	**Fiber**	**Oil**	**Ash**	**Starch**	**Moisture**
Varieties	4	31.703**	1.454**	1.425**	1.718**	4.055**	1.803**
Ex. Error	10	0.003	0.001	0.001	0.020	0.173	0.002
Total	14						

As shown in table 2, the mean squares of cultivars were highly significant for total N, Ca, K, and Mg, but the mean squares of P were significant. These results confirm that there was high variability among cultivars due to these components.

Table2: Means squares of some element component of pea varieties

S.O.V	d.f	M.S				
		Total N	**Ca**	**K**	**Mg**	**P**
Varieties	4	0.813**	0.017**	0.111**	0.0009**	0.008*
Ex. Error	10	9.73E-05	2.8E-06	2.8E-06	8.4E-06	0.002
Total	14					

Previous workers indicated that the grain legumes are important protein feedstuffs, especially in organic farming. Both the crop yield and the crude nutrients content of grain legumes are influenced by the site of cultivation, harvest year, and variety (Wang & Daun, 2004). Even in conventional farming, the amounts of the crude nutrients, mainly of carbohydrates and crude protein, can vary widely (Avola et al., 2009), (Burstin et al., 2011), (De Almeida Costa et al., 2006) and (Duc et al., 1999).

Data in table 3 explain the differences among cultivars regards to some chemical components of a pea. Concerning to Protein content, the maximum value 26.63% recorded by local wild, which predominated the rest by the percentage increase 14.50, 26.86, 26.62, and 28.77%, respectively. The lowest value of protein content was 18.97% recorded by Avola. In this regard, protein contents of peas are known to vary with soil type and nitrogen application (Igbasan et al., 1996), location and year (Ali-Khan & Youngs, 1973) and genotypes (Matthews & Arthur 1985). Regarding to fiber content represent in the same table, the highest value was 4.27% recorded by Jeza, which exceeded the rest by the percentage increase 27.72, 25.39, 3.35, and 37.97%, respectively. The lowest percentage of fiber was 2.646% recorded by local wild. The dietary fiber contents varied between 190.7 and 223.1 g kg^{-1}, and the values were slightly higher in the brown-seeded cultivars (Igbasan etal., 1997). Concerning the oil percentage as represent in the same table, the Jeza produced the highest percentage of oil reached 3.13%, and exceeded the rest by 31.69, 44.37, 38.72, and 59.46%, respectively. The lowest value of oil percentage was 1.27% recorded by local wild. No significant differences were recorded between Avola and local wild in this trait. The lipid content of peas is low and ranges from 0.8 to 6.1% for whole seeds (Savage and Deo., 1989). The principal varieties used for canning, such as Citrina or Manuela, are wrinkled, and (Coxon & Davies, (1982) have shown that wrinkled peas contain between 4.5 and 5.2% as total lipid content while round-seeded varieties contain only 2.8 to 3.1%. Although low, crude oil content may be of importance in the flavor of peas (McCurdy et al., 1983). Data respect to ash content present in table 3, indicated to the presence of highly significant differences among cultivars due to this trait. The highest value was 6.83% recorded by the local wild, which was not significantly different from the Americana. The lowest value recorded by Jeza with 5.36%, which was not morally different from Pakland and Avola. In a study by (Wang et al., 2010), the content of ash in pea seeds depended on a study year, plot location, and cultivar. In the cited work, the ash content ranged from 2.57 to 2.79%. Recorded data on starch content represented in table 3 confirm the highest significant differences among cultivars. Local wild recorded maximum value for this trait reached 42.71% and predominated the rest by 3.51, 5.17, 4.99, and 7.53%, respectively. The lowest value recorded by Avola with 39.57%. No significant differences were recorded among the cultivars American, Jeza, and Pakland, and also among Jeza, Pakland, and Avola in this trait. Some reviews showed that starch content in the seed varied from 18.6 to 54.5 g 100 g^{-1} (Nikolopoulou et al., 2007), (Piecyk et al., 2012), (Pratap& Kumar 2011), (Urbano et al., 2005) and (Wang & Daun, 2004). Data represent in table 3 illustrate the means of cultivars for moisture percent. The values were restricted between 9.75 to 11.71% for both local wild and Jeza. Other authors observed diverting results, especially for crude protein and starch, as well as comparable results for ether extract, ash, and crude fiber. High variations of the composition of field peas were found (Bastianelli et al., 1998), (Jezierny et al., 2011), (Ravindran et al., 2010) and (Schumacher et al., 2009) about high differences in the selection of varieties.

Previous workers indicated that the variety of field peas has an impact on its crude protein content as well as on many component parts like other crude nutrients, (Canbolat et al., 2007), (Guillamón et al., 2008), (Kotlarz et al., 2011) and (Wang et al., 2008). The research conducted by (Wang et al., 2010) demonstrated significant differences in the content of protein, starch, crude fiber, fat, ash, and phytates in pea seeds depending on a cultivation system and study site.

Table 3: means of some chemical components of pea varieties

Varieties	Protein%	Fiber%	Oil%	Ash%	Starch%	Moisture%
Americana	22.770 b	3.126 c	2.140 b	6.693 a	41.207 b	11.510 b
Jeza	19.480 c	4.266 a	3.133 a	5.363 b	40.507 bc	11.710 a
Pakland	19.543 c	3.183 c	1.743 d	5.366 b	40.580 bc	11.273 c
Avola	18.970 d	4.123 b	1.920 c	5.420 b	39.570 c	10.913 d
Local wild	26.633 a	2.646 d	1.270 e	6.830 a	42.713a	9.750 e
LSD.0.05	0.109	0.058	0.072	0.254	0.740	0.089
LSD.0.01	0.153	0.081	0.101	0.356	1.037	0.126

*The means followed by the same letter do not differ from each other significantly, but for the means followed by a different letter, they differ significantly.

Data in table 4 explain the means of some elements of pea cultivars, indicating to the highly significant differences among cultivars for all elements except the phosphorus%, which was significant only. Regarding to Total Nitrogen, the highest value was 4.26% recorded by Local wild. While the lowest value recorded by Avola was 3.04%. Not significant differences were recorded between Jeza and Pakland for this trait. Concerning the percentage of Ca, the Local wild produced the highest value reached 0.31%m while the lowest value of this element was 0.12% recorded by Americana. As shown in the same table, the percentage of K reached 1.22% as the maximum value by Pakland, but the lowest percent was 0.77% recorded by Avola. The percentage of Mg of pea varieties present in the same table confirmed that the Pakland exhibited the maximum percent of Mg% reached 0.15%, but the lowest percent was 0.10% recorded by Avola. No significant differences were recorded between Americana and Avola in this trait. From the same table, the significant differences were observed between cultivars due to P%. Local wild produced maximum P% reached 0.15%, while Pakland gave the lowest P% with 0.01%. No significant differences were noticed among Americana, Jeza, Avola, and Local Wild and also among Americana, Jeza , Pakland and Avola cultivars. Several studies confirmed that the variety of field peas influences on its minerals (Canbolat et al., 2007), (Guillamón et al., 2008), (Kotlarz et al., 2011) and (Wang et al., 2008).

Table 4: means of some elements of pea varieties

Varieties	Total N	Ca	K	Mg	P
Americana	3.647 b	0.118 e	1.202 b	0.105 d	0.033 ab
Jeza	3.120 c	0.162 d	1.155 c	0.120 c	0.071 ab
Pakland	3.130 c	0.257 b	1.220 a	0.145 a	0.013 b
Avola	3.038 d	0.231 c	0.767 e	0.100 d	0.036 ab
Local wild	4.265 a	0.312 a	0.967 d	0.127 b	0.147 a
LSD. 0.05	0.017	0.002	0.002	0.005	0.091
LSD. 0.01	0.024	0.004	0.004	0.007	n.s

The means followed by the same letter do not differ from each other significantly, but for the means followed by a different letter, they differ significantly.

Data in table 5 illustrate the relation between each pairs of studied traits of pea. highly significant and negative correlation was recorded between protein% and fiber% ($r = -0.813$, $p < 0.01$) , while highly significant and positive association was noticed between protein% with Ash, starch and P% (r = 0.927, 0.958 and 0.789 , p < 0.01) respectively , but significant and negative correlation was observed between protein and moisture % (r = -0.745, p < 0.05). Positive and highly significant correlation was recorded between fiber% with oil% (r = 0.769, p < 0.01), while highly significant and negative association was observed between fiber% with ash and starch% (r = -0.771 and -0.830, p < 0.01) respectively. The correlation between oil% and moisture% was positive and highly significant % (r = 0.804, p < 0.01), while it was negative and significant with Ca% (r = -0.739, p < 0.05). The ash% showed positive and highly significant correlation with starch% (r = 0.837, p < 0.01). The correlation between starch% with moisture% was negative and significant % (r = -0.655, p < 0.05), while it was positive and highly significant with P% (r = 0.780, p < 0.01). The moisture % showed negative and highly significant correlation with Ca% (r = -0.832, p < 0.01), while recorded negative and significant correlation with P% (r = -0.764, p < 0.05). A significant negative relationship (*r* = –0.78, *P* ² 0.01) between starch and protein contents was observed (Igbasan etal., 1997). The association between protein and fiber contents showed a non-significant negative correlation (*r* = –0.46, *P* <0.05) 17). Not significant correlation was recorded previously between crude protein and each of chemical elements (Sharma & sharma, 2012). Negative correlation was found between oil absorption capacity and starch (r = -0.65, *p* < 0.01) and positive correlation was found between oil absorption capacity and Soluble dietary fiber (r = 0.72, *p* < 0.01). For the hot absorption, it showed very strong positive correlations with Total dietary fiber and Insoluble dietary fiber (r = 0.93 and 0.94, respectively, *p* < 0.01) and negative correlations with protein and starch (r = -0.88 and -0.88, respectively, *p* < 0.01) (Xu., 2017). Negative correlation between protein and starch concentrations in pea samples is demonstrated by previous studies (Karunakaran etal., 2019).

Table 5: Correlation coefficient among each pairs of traits.

	Protein %	Fiber%	Oil%	Ash%	Starch %	Moisture %	Ca%	K%	Mg%	P%
Protein%	1									
Fiber%	-0.813**	1								
Oil%	-0.574	0.769**	1							
Ash%	0.927**	-0.771**	-0.483	1						
Starch%	0.958**	-0.830**	-0.481	0.837**	1					
Moisture%	-0.745*	0.595	0.804**	-0.532	-0.655*	1				
Ca%	0.359	-0.422	-0.739*	0.049	0.370	-0.832**	1			
K%	-0.024	-0.249	0.333	0.051	0.196	0.542	-0.434	1		
Mg%	0.079	-0.416	-0.240	-0.166	0.319	-0.139	0.518	0.509	1	
P%	0.789**	-0.379	-0.280	0.563	0.780**	-0.764*	0.499	-0.278	0.084	1

** Significant 0.01 * significant 0.05

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