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Some Nutritional Characteristics of Kernel and Oil of Peanut (*Arachis hypogaea* L.)

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Abstract: Some nutritional properties of the peanut kernel and oils were established. The oil yields from these kernels vary from 32.7 % to 45.4 %. The content of protein ranged between 25.9 % to 32.4 %, with a mean value of 28.93 %. The mineral contents of peanut kernels were determined by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). The contents of Na ranged from 867.7 mg/kg to 1186.1 mg/kg, with a mean value of 1004.7 mg/ kg. The phosphor contents of kernels ranged between 2769.7 mg/kg to 3784.9 mg/kg, with a mean value of 3433.91 mg/kg. The oil had a refractive Index (n 20) between 1.451 to 1.461 and a saponifiable value between 165.3 to 187.6. The main fatty acids in peanut kernel oils are oleic, linoleic and palmitic. Statistical differences between parameter to locatins were important at $p<0.05$. As a result, the present study showed the peanut kernels of the researched species of *Arachis* kernels from Turkey to be a potential source of valuable oil which might be used for edible and other industrial applications.

Key words: peanut, *Arachis hypogaea*, Leguminoseae, kernel, location, oil, mineral, fatty acid

1 INTRODUCTION

Arachis hypogaea (peanut) is a member of the family Leguminoseae, native to South America, Mexico and Central America, which grows in Southern Turkey. It is widely distributed in the tropics and moderate regions. It is an annual herbaceous plant growing to 30 to 50 cm tall. Peanuts are also known as earthnuts, goobers, goober peas, pindas, jack nuts, pinders, manila nuts. Peanut is an important source of edible oil for millions of people living in the semitropic region[1,2]. Peanut is located mainly in the Mediterranean and partly South-West Anatolian coastline. In Turkey, 63.800 tons of peanuts are being produced annually[3]. Some of the kernels are consumed in the roasted form. A larger percentage is used for the production of vegetable oil. The oil is used in the manufacture of salad or further processed to produce margarine[4,5].

Peanuts are mostly consumed as snack food after roasting like other nuts[6]. Peanuts make an important contribution to the diet in many countries. Peanut kernels are a good source of protein, lipid and fatty acids for human nutrition. Peanut oil is a mainly monounsaturated fat, much of which is oleic acid, the healthful type of fat that has been implicated for skin health. The major producers/exporters of peanuts are the United States, Argentina, Sudan, Senegal, and Brazil. The peanut, grown primarily for human consumption, has several uses as whole seeds or is processed to make peanut butter, oil, and other products. The seed contains 25 to 32% protein (average of 25% digestible protein) and 42 to 52% oil[7-9]. Oil, protein, alcohol-soluble sugars, mineral, ash and lignin contents of 3 Virginia-type peanut kernels were established by Wallerstein *et al.*[10]. Peanut kernels are rich in oil, naturally containing from 47 to 50%. Oil quality and its stability are very important for the consumers[6]. The composition of kernel and its oil of several cultivars of peanut were carried out[11]. Sheppard and Rudolf[12] researched total lipids, fatty acids and proximates properties of peanuts and peanut products. Çelik[2] determined proximate analyses and fatty acid composition of peanut seeds growing in Turkey. Özcan and Seven[11] determined the physical and chemical properties and fatty acid composition of peanuts, peanut butter and their oils from Turkey.

The aim of this study was to determine the some physical and nutritional properties of *A. hypogaea* kernels collected from several locations of Turkey.

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2 EXPERIMETALS

2.1 Material

Peanut (*A. hypogaea*) kernels were collected from different locations [Silifke (Mersin), Anamur (Mersin), Alanya (Antalya), Aydıncık(Mersin), Osmaniye, Bucakışla (Karaman), Büyükeceli (Gülnar-Mersin)] of in Turkey. Kernels were transported to the laboratory in polypropylene bags and held at room temperature. They were cleaned in an air screen cleaner to remove all foreign matter such as dust, dirt and immature and broken kernels were discarded as well. Their moisture content was measured on arrival.

2.2 Methods

The weight of 1000 kernels were determined by weight of 250 peanut kernels. The chemical properties (moisture, crude oil, crude fibre, ash, acidity, relative density, refractive index, peroxide value, saponification number and unsaponifable matter) were analyzed according to AOCS[13] methods. Peanut kernels were ground, and oil was extracted for 8 h with petroleum ether in a soxhlet apparatus. Then, the solvent was completely removed under reduced pressure in a rotary evaporator. Oil percentages were determined by weight difference. The protein content was determined by the Kjeldahl method according to Grosso *et al.*[14].

2.3 Determination of fatty acids

Faty acids were formed using the boron trifluoride method[15]. The working conditions of gas chromatography were as follows.

Instrument: Varian 2100
Constant phase:10% DEGS (diethylene glycol succinate) + 1% H_3PO_4
Support matter: Chromosorb G (100/120 mesh)
Column: stainles steel (190 cm length x 0.2 μm i.d.)
Detector: FID (Flame Ionization Detector)
Temperatures:
Column : 200℃
Injector : 225℃
Detector : 225℃
Flow rates :
Carrier gas (N_2) : 6 mL /min.
Burnt gas (H_2) : 40 mL/min.
Dry gas (O_2) : 60 mL/min.
Injection amount : 5 μL

2.4 Determination of mineral contents

About 0.5 g of dried and ground peanut kernels was put into burnig cup with 15 mL of pure NHO_3. The sample was incinerated in a MARS 5 microwave oven at 200℃. Distilled deionized water and ultrahigh-purity commercial acids were used to prepare all reagents, standards, and peanut samples. After digestion treatment, samples were filtrated through whatman No 42. The filtrates were collected in 50 mL Erlenmayer flasks and analysed by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). The mineral contents of the samples were quantified against standard solutions of known concantrations which were aralyzed concurrently[16].

Working conditions of ICP-AES:

Instrument	:ICP-AES (Varian-Vista
RF Power	:0.7-1.5 kw (1.2-1.3 kw for Axial)
Plasma gas flow rate (Ar)	:10.5-15 L/min. (radial) 15" (axial)
Auzilary gas flow rate (Ar)	:1.5 "
Viewing height	:5-12 mm
Copy and reading time	:1-5 s (max.60 s)
Copy time	:3 s (max. 100 s)

2.5 Statistical analyses

Results of the research were analysed for statistical significance by analysis of variance.[17]. This research was performed by three replicates.

3 RESULTS AND DISCUSSION

The physico-chemical properties and mineral contents of peanut kernels are given in Table 1. The contents of protein ranged between 25.9 % (Bucakışla) to 32.4 % (Osmaniye), with a mean value of 28.93 %. The oil content of kernel varied between 32.7 % (Osmaniye) to 45.4 % (Anamur), with a mean value of 39.8%. The protein, oil, crude fibre and ash values of peanut kernels were found similar compared with reports of Çelik[2] and Özcan and Seven[11]. Özcan and Seven[11] determined 6.07 an 5.59 % moisture, 36.93 % and 35.97 % protein and 44.09 % and 31.52 % oil in ÇOM and NC-7 peanut cultivars, respectively. Protein contents were found low according to results of Özcan and Seven[11]. It will be seen that there are significant variations in some chemical composition of most of these kernels[18,19]. Peanut are characterized by high oil and protein contents and low ash. Knowledge of these components is important in the end- products of the industry of peanut[1]. Locations were affect on chemical composition of peanut kernels. The mineral contents of peanut kernels were determined by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES). All kernels contained Na, P and K at the high rate. The contents of Na ranged from 867.7 mg/kg (Alanya) to 1186.1 mg/kg (Osmaniye), with a mean value of 1004.8 mg/ kg. The phosphor contents of kernels ranged between 2769.7 mg/kg (Silifke) to 3784.9 mg/kg (Bucakışla), with a mean value of 3433.91 mg/kg. In addition, the potassium contents of kernels varied between 67619.6 mg/kg (Anamur) to 98967.4 mg/kg (Büyükeceli), with a mean value of 86036.2 mg/ kg. Özcan and Seven[11] reported Na (7811.2 and 148114.4 mg/kg), K (207649 and 241206 mg/kg), Ca

Table 1 Some Physico-Chemical Properties and Mineral Contents of Peanut Kernels (n:3).

Locations	Moisture (%)	Crude Protein (%)	Oil (%)	Crude Fibre (%)	Ash (%)	Weight of 1000 kernels (g)	Na (mg/Kg)	P (mg/Kg)	K (mg/Kg)
Silifke	5.63[a] ± 0.07[b]	27.4 ± 1.3	43.7 ± 3.6	1.17 ± 0.04	1.74 ± 0.13	971.4 ± 19.7	971.4 ± 17.3	2769.7 ± 67.9	87463.7 ± 117.1
Anamur	5.71 ± 0.008	29.2 ± 1.7	45.4 ± 2.1	1.21 ± 0.01	2.17 ± 0.07	1017.1 ± 21.6	1017.1 ± 21.6	3267.1 ± 71.6	67619.6 ± 121.6
Alanya	6.18 ± 0.14	28.4 ± 1.1	39.7 ± 1.9	1.04 ± 0.06	1.84 ± 0.11	964.3 ± 17.3	867.7 ± 17.3	3647.1 ± 41.9	76891.9 ± 97.4
Aydıncık	5.97 ± 0.7	31.6 ± 2.3	41.2 ± 2.8	1.28 ± 0.04	1.91 ± 0.21	1057.4 ± 6.7	871.9 ± 6.7	3342.1 ± 67.4	88171.5 ± 126.1
Osmaniye	6.24 ± 0.11	32.4 ± 2.4	32.7 ± 2.6	1.31 ± 0.01	2.36 ± 0.09	1069.3 ± 27.3	1186.1 ± 27.3	3546.7 ± 81.9	96197.4 ± 119.2
Bucakı¸sla	6.71 ± 0.71	25.9 ± 1.9	35.3 ± 1.7	1.12 ± 0.07	1.61 ± 0.04	954.3 ± 14.6	1142.3 ± 14.6	3784.9 ± 76.1	86941.8 ± 115.3
Büyükeceli	6.07 ± 0.09	27.6 ± 1.4	40.4 ± 3.8	1.13 ± 0.04	1.87 ± 0.03	986.9 ± 16.4	977.1 ± 16.4	3679.8 ± 87.6	98967.4 ± 127.6
Total	6.07 ± 0.26	28.93 ± 1.7	39.8 ± 2.64	1.18 ± 0.03	1.93 ± 0.09	1002.9 ± 17.7	1004.7 ± 17.3	3433.9 ± 70.6	86036.2 ± 117.7

[a] Results are mean values of triplicate determinations

[b] Standard deviation

Table 2 Some Physico-Chemical Properties of Peanut Oils.

Locations	Acidity (oleic %)	Peroxide Value (meq/kg)	Refractive Index (n20D)	Relative Density (d2020)	Saponifiable Value	Unsaponifiable matter(g)
Silifke	0.71[a] ± 0.06[b]	1.06 ± 0.01	1.451 ± 0.021	0.957 ± 0.003	180.1 ± 12.1	0.71 ± 0.01
Anamur	0.96 ± 0.01	1.11 ± 0.07	1.457 ± 0.014	0.955 ± 0.002	187.6 ± 13.4	0.98 ± 0.01
Alanya	1.11 ± 0.02	1.09 ± 0.06	1.453 ± 0.012	0.957 ± 0.013	179.2 ± 16.3	0.67 ± 0.03
Aydıncık	0.99 ± 0.04	0.97 ± 0.03	1.461 ± 0.009	0.959 ± 0.011	165.3 ± 22.6	0.84 ± 0.01
Osmaniye	1.26 ± 0.06	0.86 ± 0.02	1.454 ± 0.11	0.961 ± 0.008	171.9 ± 18.3	1.07 ± 0.05
Bucakı¸sla	1.07 ± 0.02	1.06 ± 0.17	1.456 ± 0.007	0.954 ± 0.014	183.6 ± 17.6	1.12 ± 0.03
Büyükeceli	0.86 ± 0.01	0.95 ± 0.09	1.457 ± 0.017	0.958 ± 0.009	181.8 ± 9.8	1.04 ± 0.05
Total	0.99 ± 0.03	1.01 ± 0.06	1.456 ± 0.013	0.957 ± 0.009	178.5 ± 15.7	0.92 ± 0.03

[a] Results are mean values of triplicate determinations

[b] Standard deviation

Table 3 Fatty Acid Composition of Peanut Oils (%).

Locations	Palmitic	Stearic	Oleic	Linoleic	Lirolenic	Arachidic
Silifke	9.21[a] ± 1.12[b]	2.14 ± 0.04	51.6 ± 2.6	27.3 ± 1.2	0.62 ± 0.01	1.44 ± 0.01
Anamur	8.67 ± 0.71	3.21 ± 0.07	48.4 ± 3.1	29.6 ± 1.7	1.01 ± 0.01	1.53 ± 0.09
Alanya	11.41 ± 0.64	2.43 ± 0.05	57.3 ± 4.6	34.9 ± 2.1	1.12 ± 0.03	1.67 ± 0.21
Aydıncık	10.26 ± 0.82	2.61 ± 0.03	54.6 ± 1.9	35.1 ± 1.9	0.37 ± 0.01	2.24 ± 0.07
Osmaniye	9.31 ± 0.56	3.07 ± 0.01	53.7 ± 1.8	38.3 ± 0.9	0.44 ± 0.05	1.83 ± 0.06
Bucakı¸sla	7.63 ± 0.47	4.13 ± 0.04	49.3 ± 1.4	30.6 ± 1.1	1.11 ± 0.01	2.36 ± 0.03
Büyükeceli	9.92 ± 0.51	2.86 ± 0.07	51.4 ± 3.6	29.7 ± 0.8	0.98 ± 0.07	1.78 ± 0.01
Total	9.487 ± 0.69	2.92 ± 0.04	52.3 ± 2.7	32.2 ± 1.4	0.80 ± 0.03	1.84 ± 0.07

[a] Results are mean values of triplicate determinations

[b] Standard deviation

(79449.9 and 89377.9 mg/kg) and P (402013 and 491860 mg/kg) at the high amount. Özcan[20] determined 644.56 mg/kg Ca, 6035.9 mg/kg K, 1377.2 mg/ kg Mg and 3972.3 mg/kg P, in peanut kernel. It is noteworthy that minerals are important not only for human nutrition but for plant nutrition as well[21]. Minor and major differences in mineral contents of peanut kernels could be probably due to differences in climatic conditions, soil structure and environmental temperature during maturation of peanut seeds.

The extracted oil was yellowish in colour. Its physical and chemical characteristics are given in Table 2. The oil had a relative density between 0.954 to 0.961 d^{20}_{20}, refractive Index (n^{20}_{D}) between 1.451 to 1.461, a saponifiable value between 165.3 (Aydıncık) to 187.6 (Anamur), and an unsaponifiable between 0.67 g (Alanya) to 1.12 g (Bucakışla). Peroxide and acidity values oils were found lower when compared with analyses results of peanut kernels obtained from Patancheru, India of Jambunathan *et al*. (1993)[6].

The fatty acid composition of seed oil triacylglycerides varies widely among different plant species and often the occurrence of unusual fatty acids is characteristic for particular plant families[22]. On the other hand, most seeds contain fatty acids commonly present in seed oils, such as saturated fatty acids such as palmitic or stearic acid and unsaturated fatty acids such as oleic, linoleic, or linolenic acid in different proportions.

According to the results shows in Table 3 the most predominant fatty acid of all kernel oils of peanut was oleic acid, which accounted for 48.4 % (Anamur) to 57.3 % (Alanya) in oils, with a mean value of 52.33 % . The highest value for oleic acid was found in Alanya sample. In addition to oleic acid, kernel oils of peanut contained higher amounts of linoleic acid. The range of linoleic acid was between 27.3% (Silifke) to 38.3 % (Osmaniye), with a mean value of 32.2%. The kernel oils of peanut also contain appreciable amounts of saturated fatty acids, especially palmitic and stearic acids. Gyu-Jeong[23] determined chemical composition of peanuts from plants. Predominant fatty acids in free acids were oleic, linoleic, palmitic and arachidic acid. Anderson *et al*.[24] studied the relationship between fatty acid composition of 6 high oleic acid peanut genotypes. While palmitic and oleic acid contents of peanut kernel oils belong to Bucakışla locations are found low, stearic and arachidic acids values were established high. Linoleic acids contents of locations ranged depending on locations.

The range of concentrations of the fatty acids was similar to the previous published data[2,11,19,25]. The variations observed between the results of this work could be probably due to differences in climatic conditions, soil structure and environmental temperature during maturation of peanut seeds[1]. These findings may be useful for dietary information, which requires prior knowledge of the nutritional composition of nuts. The high oil and protein contents suggest that this kernel can be of use in the food industry.

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