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COOKING QUALITY AND COMPOSITION OF CHICKPEAS GROWN IN TURKEY

TÜRKİYE'DE YETİŞTİRİLEN NOHUT ÇEŞİTLERİNİN PİŞME KALİTESİ VE KOMPOZİSYONU

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SUMMARY: Seven chickpea genotypes grown at two locations in Turkey were analyzed for physical criteria, cooking quality, and mineral, thiamine and riboflavin contents. The swelling index, hydration index, dry and wet cooking times, and the K, Ca, Mg, Na and riboflavin content were all influenced primarily by genotype. The growing location was the principal source of variation for dry and wet weight, dry and wet volume, hydration and swelling capacity, and the Cu, Zn, and thiamine content. Zn and P content were significantly correlated ($P<0.05$) with the wet cooking time. Swelling index was significantly correlated ($P<0.01$) with the dry cooking time.

ÖZET: Türkiye'de 2 bölgede yetiştirilen 7 nohut genotiplerinin fiziksel kriterleri ve pişme kalitesi ile mineral madde, tiyamin ve riboflavin miktarları saptanmıştır. Şişme indeksi, hidrasyon indeksi, kuru ve yaş pişme süresi ile K, Ca, Mg, Na ve riboflavin miktarları başlıca genotipden etkilenmiştir. Kuru ve yaş ağırlık, kuru ve yaş hacim, hidrasyon ve şişme kapasitesi ile Cu, Zn ve tiyamin miktarı ise çevreden etkilenmiştir. Zn ve P miktarı önemli düzeyde ($P<0.05$) pişme süresi ile ilişkili olmuştur. Şişme indeksi ise kuru pişme süresi ile önemli düzeyde ($P<0.01$) ilişkili olmuştur.

INTRODUCTION

Food legumes, such as lentils, chickpeas, and dry beans make a significnat contribution to the Middle Eastren diet. The utilization of food legumes in the Eastren Mediterranean region is thought to date back 8000 years ago (ABU-SHAKRA and TANNOUS, 1981). After cereals, food legumes are one ofthe most important source of proteins, calories, and other nutrients in Turkey. Therefore, it is worthwhile to investigate the cooking quality and composition of food legumes grown in Turkey.

Several factors have been reported to affect cooking quality in food legumes. Although the reason is not well understood, it has been indicated that the growing location and environment has a major influence on the cooking quality of lentils (BHATTY et al 1983, BHATTY 1984). It has been results of studies show that the cooking quality of peas may be associated with the ratio of monovalent and divalent cations; also a high P level in the soil contributies to high phytin content in the seed and consequently to high cooking quality (MATTSON 1946, MATTSON et al 1950). Food legumes which are difficult to cook are thought to be affected by the presence of insoluble pectins in the cell wall. Insoluble Ca and Mg pectates are formed in the cell walls when the seeds are rich in terms of these minerals.

The nutritional value, flavor, odor, and texture of the cooked product and especially the cooking time are significant aspects of cooking quality in food legumes. A majority of studies, examining the cooking and nutritive quality of chickpeas have used the desi type of chickpeas. One study carried out at ICARDA investigated the cooking quality and ther elationship between cooking time and some physical characteristics in both desi and kabuli type of chickpeas (WILLIAMS et al 1983).

The cooking quality of peas, beans, chickpeas, and lentils has been investigaed in several studies (MATTSON et al 1950, MULLER 1967, IYER et al 1980, WILLIAMS et al 1983, BHATTY 1984). But the detailed studies investigating a possible relatinship between the quality criteria and the mineral matter and vitamin contents were not to be found in the literature.

In this study the effect of genotype and growing location on the quality parameters and composition of chickpeas grown in Turkey and their relationships were investigated.

MATERIALS AND METHODS

Seven genotypes of chickpeas (six advanced lines and one variety. Güney Sarısı) grown in two locations in Turkey were used in this study. The growing locations were Haymana (in Central Anatolia) and İzmir (in the Aegean Coastal region). The climatic conditions of these locations during the growing season are summarized in Table 1. Sowing and harvesting times were in late April and at the begining of August for the Haymana location, and the serespective activities were in the middle of February and in late July for the İzmir location. These two locations have distinct climatic properties and are in different parts of the country; they were especially chosen in order to show the variation in cooking quality and composition of chickpeas grown in Turkey.

The quality criteria, dry and wet seed weights, dry and wet seed valumes, hydration capacity and index, swelling capacity and index and the dry and wet cooking times were determined according to the methods of Williams et al (1986).

Samples for mineral element measurements were prepared by dry ash methods (ANONYMOUS, 1970). Following this preparation, a Perkin Elmer A.A. 1100 Atomic Absorption Spectrophotometer was used for the determination of Fe, Cu, Zn, Mg, Mn and Ca contents (ANONYMOUS, 1972). Samples were analyzed for Na and K using a Flamephotometer M/D, in which acetylene was used as the supporter gas during analyses and 1 % Lanthan solution was used to avoid P interference during the Ca assay (GARCIA et al 1972). P content was determined by the method of vanadomolybdophoric yellow color using a Pye-Unicam SP/550 spectrophotemeter (ANONYMOUS, 1970). Thiamine content was determined by using the method of FREED (1966) and riboflavin content was determined according to AACC Approved Method (ANONYMOUS, 1962).

RESULTS AND DISCUSSION

Physical criteria, cooking time, mineral content, thiamine and riboflavin contents of the samples harvested from two locations were determined and the results are presented in tables 2 and 3. The large range for most criteria can be observed from these tables. This is probably due to the qualitative diversity of chickpea genotypes and the clear differences between the two locations in terms of climatic conditions (Table 1) and soil composition. The over all ranges in dry cooking time and dry seed weight were 120-160 min and 26.28-42.25 g, respectively. A soaking process reduced the cooking time in the chickpea samples tested, and the wet coking time was between 35-95 min. The ranges were reported to be between 95-200 min for the dry cooking time and 9.2-54.1 g for dry seed weight in kabuli types chikpeas (WILLIAMS et al 1983). Chickpeas are generally rich in various minerals, especially Fe, Ca and K. Thiamine and niacin composition of chickpeas are comparable with that of lentils, but the riboflavin content is lower. In the present study Ca, Fe, Zn, Na, thiamine and riboflavin contents were comparable to values reported in the literature (PELLET and SHADAREVIAN, 1970, ABUSHAKRA and TANNOUS 1981).

The effects of location and genotype are calculated using analyses of variance. The genotype and location affected all criteria significantly ($P<0.05$). In oder to evaluate the influence of genotype and location on each criterium, the sum of squared values were compared (MATSUO et al 1982). Some of the quality criteria (swelling index, hydration index, dry and wet cooking time), and the contens of K, Ca, Mg, Na and riboflavin found to be influenced primarily by genotype. The growing location was the principal source of variation for dry and wet weight, dry and wet volume, hydration and swelling capacity, and the Cu, Zn, and thiamine content.

Simple corelation coefficients were calculated for dry and wet cooking time and all other quality criteria, as well as mineral and vitamin contents. Correlation coefficients higher than 0.400 are presented in Table 4. The seed size, whether measured in terms of weight or volume, were positively correlated with wet and dry cooking times. However the correlation values were not significnat and lower than reported the literature values (WILLIAMS et al 1983). Zn and P content were significnatly correlated ($P<0.05$) with the wet cooking time. The swelling index was significantly correlated with the dry cooking time ($P<0.01$).

Table 1. Climatic conditions of the locations during the growing season

Location	Months												
	1	2	3	4	5	6	7	8	9	10	11	12	Toplam
Haymana													
Precipitation (mm)	23.0	26.6	69.0	56.4	35.1	42.2	4.9	0.8	-	77.5	51.3	5.6	392
Temperature (^{o}C)	-0.3	0.6	2.8	9.4	13.8	16.7	21.3	21.2	16.8	3.8	1.8	2.0	110
İzmir													
Precipitation (mm)	29.2	69.6	120.9	29.9	8.3	0.9	-	-	0.6	1.0	113.4	86.2	460
Temperaure (^{o}C)	8.6	8.4	10.3	14.2	19.6	24.1	28.5	26.5	21.8	16.5	9.6	9.0	197

Source: Republic of Turkey, General Directorate of Meteorology

Table 2. Physical and physicochemical parameters and the cooking time of some chickpea lines and a cultivar grown at two locations

	Seed Weight		Hydration		Volume		Swelling		Cooking time	
	Dry (g/100 seeds)	Wet (g/100 seeds)	capacity	index	Dry (ml/100 seeds)	Wet (ml/100 seeds)	Capacity	index	dry (min)	wet (min)
LOCATION : HAYMANA										
G.Sarısı	26.28	54.40	0.281	1.069	20.0	47.5	0.275	1.375	135	35
Line-1	31.96	64.21	0.323	1.009	24.0	56.0	0.320	1.333	130	40
Line-2	31.56	65.64	0.341	1.081	24.5	58.0	0.335	1.367	135	35
Line-3	29.96	63.21	0.333	1.110	23.0	55.5	0.325	1.413	150	60
Line-4	29.68	66.08	0.334	1.022	25.5	58.0	0.325	1.274	120	45
Line-5	31.24	65.04	0.338	1.083	24.0	57.0	0.330	1.378	138	60
Line-6	30.63	63.37	0.328	1.069	23.0	55.5	0.325	1.413	140	85
Mean	30.52	63.14	0.325	1.063	23.4	55.4	0.319	1.324	135	51
LOCATION: İZMİR										
G.Sarısı	34.36	69.93	0.356	1.035	26.0	61.0	0.350	1.346	145	85
Line-1	42.25	84.19	0.420	0.993	31.5	73.0	0.415	1.318	135	60
Line-2	40.21	82.15	0.420	1.043	29.5	71.5	0.420	1.424	150	55
Line-3	39.91	81.62	0.417	1.045	29.5	71.0	0.415	1.408	160	95
Line-4	40.99	82.34	0.414	1.009	30.0	71.5	0.415	1.384	120	60
Line-5	38.22	78.82	0.406	1.063	28.5	68.5	0.400	1.404	150	80
Line-6	37.38	75.66	0.383	1.025	27.5	66.0	0.385	1.400	150	90
Mean	39.05	79.24	0.402	1.030	28.9	68.9	0.400	1.383	144	75

Table 3. Mineral and vitamin composition of some chickpea lines and a chickpea cultivar grown at two locations*

	Fe	Cu	Zn	Mn	P	K	Ca	Mg	Na	Thiam.	Ribof
LOCATION : HAYMANA											
G.Sarısı	5.98	0.73	2.52	2.46	368.4	1189	142.22	130.08	42.00	0.455	0.138
Line-1	5.68	0.65	2.63	2.10	264.2	1240	129.38	131.21	54.06	0.418	0.135
Line-2	5.44	0.57	2.56	2.12	291.0	1389	125.55	138.18	59.88	0.572	0.166
line-3	5.18	0.84	2.72	2.00	306.5	1315	128.88	147.40	55.84	0.600	0.155
Line-4	4.77	0.71	2.62	1.95	376.9	1275	131.10	149.87	52.99	0.490	0.156
Line-5	5.81	0.79	2.46	2.05	328.3	1416	117.26	133.00	41.4	0.527	0.148
Line-6	5.31	0.62	2.56	2.22	351.1	1204	137.20	134.20	43.54	0.463	0.158
Mean	5.45	0.70	2.58	2.13	326.6	1290	130.23	137.71	49.96	0.504	0.151
LOCATION : İZMİR											
G.Sarısı	5.06	1.12	4.39	1.89	346.0	1333	134.36	133.66	55.94	0.336	0.152
Line-1	4.92	1.17	4.90	2.11	394.9	1356	118.44	131.17	84.88	0.281	0.146
Line-2	4.87	1.26	5.07	2.04	390.7	1480	121.48	133.72	67.00	0.290	0.165
line-3	4.82	1.16	5.03	2.16	410.0	1479	128.28	135.52	61.54	0.327	0.139
Line-4	5.86	1.35	5.11	2.22	292.5	1450	121.88	134.30	57.06	0.285	0.155
Line-5	5.77	1.01	4.84	1.97	400.0	1484	116.92	131.72	60.01	0.272	0.144
Line-6	5.14	1.06	4.93	1.92	436.2	1348	121.80	132.44	41.50	0.295	0.166
Mean	5.21	1.16	4.90	2.04	381.5	1419	123.31	133.22	61.13	0.298	0.152

* All values are given as mg/100 g on dry basis

Table 4. Correlative relationship between cooking time and other quality criteria and mineral contents

	Cooking Time	
	Wet	Dry
Dry weight	0.425	0.187
Wet weight	0.453	0.250
Hydration capacity	0.479	0.316
Wet volume	0.451	0.252
Swelling capacity	0.484	0.316
Swelling index	0.439	0.684**
Zn	0.559*	0.376
P	0.546*	0.508
Cu	0.456	0.270

* : $P<0.05$
** : $P<0.01$

CONCLUSIONS

In this study the effect of growing location and genotype on the quality and composition of chickpea were investigated. Some of the quality criteria (Swelling index, hydration index, dry and wet cooking time) were found to be primarily influenced by genotype, and they can be used as selected criteria in breeding programs. As far the minerals K, Ca, Mg, Na contents were primarily influenced by genotype, and the Cu and Zn content were primarily influenced by the growing location. These findings indicating significant variation in the mineral composition due to genotypic difference and growing location should be considered when undertaking nutritional studies and in the preparation of food composition tables.

The effects of growing location and genotype on the quality and composition of chickpea must be investigated in a more detailed study, including the investigation of a larger number of growing locations and of chickpea genotypes. The effects of storage conditions should also be considered.

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