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COOKING QUALITY AND COMPOSITION OF DRY BEANS GROWN IN TURKEY

TÜRKİYE'DE ÜRETİLEN KURU FASULYELERİN PİŞME KALİTESİ VE KOMPOZİSYONU

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ÖZET: Türkiye'de 2 bölgede yetiştirilen 8 kuru fasulye genotiplerinin fiziksel kriterleri ve pişme kalitesi ile mineral madde, tiyamin ve riboflavin miktarları saptanmıştır. Genotip ve yetiştirme lokasyonları ile bunların interaksiyonu bütün kriterleri önemli düzeyde etkilemiştir ($P<0,05$).

Kuru ve yaş tohum ağırlığı, şişme kapasitesi ve indeksi, hidrasyon kapasitesi, kuru ve yaş hacim, kuru ve yaş pişme süresi ile Cu, Mn ve Na miktarları başlıca genotipden etkilenmiştir. Zn ve P miktarı ise çevreden etkilenmiştir. Kuru ve yaş tohum ağırlığı, kuru ve yaş hacim, hidrasyon ve şişme kapasitesi önemli düzeyde kuru ve yaş pişme süresi ile ilişkili olmuştur.

SUMMARY: Eight dry bean genotypes grown at two locations in Turkey were analyzed for physical criteria and cooking quality, and for mineral, thiamin and riboflavin contents. The genotype and growing location and their interaction affected almost all criteria significantly ($P<0.05$).

Dry and weed seed weight, swelling capacity and index, hydration capacity, dry and wet wolume, dry and wet cooking time, and the Cu, Mn, and Na contents were influenced primarily by genotype, location was the principal source of variation for Zn and P content. Dry and wet seed weight, dry and wet wolume, hydration and swelling capacity were significantly correlated with the dry and wet cooking times.

INTRODUCTION

Several factors have been reported to affect cooking quality in food legumes. Although the factors affecting the cooking quality of pulses are not well understood, the evidence suggests a predominant role of the cell walls, thickness of the palisade layer, and lignin and alpha-cellulose content of the seed coat. No indication has been found for an influence of cell contents such as starch granules or proteins. MULLER (1967) has shown a relationship between phytic acid, Ca++, Mg++, and free pectin affecting the cooking quality in a number of pulses. The cooking quality of peas, beans, chickpeas and lentils has been investigated in several studies (MATTSON et al. 1950, MULLER 1967, IYER et al. 1980, WILLIAMS et al. 1983, BHATTY 1984).

In general, chemical composition and cooking quality of beans are affected by the environment and may be controlled by variation in growing practices. It was reported that Ca and P contents of beans were not affected by the planting date at any location. Differences in thiamin and riboflavin at two locations were significant at the 1 % level (LANTZ et al. 1962). Variety and location affected the cooking quality and the content of Ca, P,B vitamins and protein of dry beans (GOUGH and LANTZ 1959, LANTZ et al. 1958).

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

MATERIALS and METHODS

Eight genotypes of dry beans (six advanced lines and two varieties, Horozoturak and ESK-855) grown in two locations in Turkey were used in this study. The growing locations were Meriç and Yenikent.

The quality criteria, dry and wet seed weights, the number of hard-coated seeds, dry and wet seed volumes, 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. (1983).

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, Mn, Mg 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 using the vanadomolybdophosphoric Yellow Color Method using a Pye-Unicam SP/550 spectrophotometer (KACAR 1972). Thiamin content was determined by using the method of FREED (1966), and riboflavin content was determined according to an AACC Approved Method (ANONYMOUS 1983).

RESULTS

Physical criteria, cooking time, mineral content, thiamin and riboflavin contents of the samples harvested from two locations were determined and the results are presented in Tables 1 and 2. The large range for most criteria can be observed from these tables. This is probably due to the qualitative diversity of dry bean genotypes and the big differences of the two locations in terms of climatic conditions and soil composition. The difference between dry and wet values of seed weights and volumes of Line-3 and Line-6 are found to be lower as compared to the other lines and cultivars. This is because of the high level of hard coated seeds in these samples. The number of hard coated seeds of Line-3 were 34 and 5 in the Yenikent and Meriç Locations, vesp. The respective values of Line-6 were 25 and 45 for Huse locations. The presence of a hard seed coat is an important quality factor affecting acceptability.

The effects of location and genotype are calculated by analyses of variance. The genotype and growing location and their interaction affected almost all criteria significantly ($P < 0.05$). Only the effect of location was not significant relating to potassium content.

In order to evaluate the influence of genotype and location on each criterium, sum of square values were compared (MATSUO et. al. 1982). Dry and wet seed weight, swelling capacity and index, hydration capacity, dry and wet volume, dry and wet cooking time, and the Cu, Mn, and Na contents were influenced primarily by genotype. Location was the principal source of variation for Zn and P.

Simple correlation coefficients were calculated between cooking time and all other quality criteria, and for the mineral and vitamin contents. The significant correlation coefficients are presented in Table3. None of the criteria determined in this study were correlated with the wet cooking time significantly at the 1% level. However, dry and wet seed weight, hydration and swelling capacity, dry and wet volume, swelling index were correlated with the wet cooking time at the 5% level. Most of the physical criteria (dry and wet seed weight, dry and wet volume, hydration and swelling capacity) were significantly correlated ($P < 0.01$) with the dry cooking time. Thiamin and riboflavin contents were not significantly correlated both with dry and wet cooking time. Among minerals only the Fe, Cu and Mg contents were significantly correlated (for Cu, $P < 0.01$) with dry cooking time.

CONCLUSIONS

In this study, the large variation which was observed in the cooking quality and composition of beans grown in Turkey could be explained by the big difference in climatic conditions and soil composition of the two locations as well as the great diversity of the bean genotypes. These two locations, with distinct climate conditions in different parts of the country were especially chosen in order to show the variation in cooking quality and composition of dry beans grown in Turkey.

In a breeding program, if a criterium is to be of value in assessing the cooking quality, it should be influenced primarily by genotype, but not by location or the interaction of the both. The quality criteria

Table 1. Physical and physicochemical parameters and the cooking time of some bean lines and cultivars grown at two locations

	Seed Weight		Hydration		Volume		Swelling		Cooking time	
	Dry	Wet	Capacity	Index	Dry	Wet	Capacity	Index	Wet	Dry
	LOCATION : YENİKENT									
Line-1	39.4	84.3	0.458	1.162	31.5	75.0	0.433	1.406	36	100
Line-2	17.4	34.5	0.171	0.983	13.5	30.0	0.165	0.226	22	55
Line-3	16.4	23.0	0.185	1.122	13.0	20.5	0.181	1.389	26	70
Line-4	37.2	77.1	0.404	1.086	28.0	67.5	0.399	1.423	25	80
Line-5	40.6	84.1	0.447	1.101	31.5	74.0	0.436	1.385	27	80
Line-6	41.5	66.5	0.471	1.133	32.5	59.0	0.462	1.421	25	100
Hor.ot.	44.3	92.8	0.500	1.130	36.0	82.5	0.478	1.327	25	100
Esk-855	42.4	88.7	0.472	1.112	33.0	78.5	0.463	1.403	31	105
Mean	34.9	68.9	0.389	1.104	27.4	60.9	0.377	1.373	27	86
	LOCATION: MERİÇ									
Line-1	30.1	72.9	0.428	1.422	26.0	64.5	0.385	1.481	30	85
Line-2	13.8	32.6	0.197	1.431	13.0	28.0	0.158	1.212	23	55
Line-3	13.5	32.3	0.207	1.532	13.5	29.0	0.172	1.275	26	65
Line-4	33.3	68.5	0.381	1.145	25.5	59.0	0.360	1.413	28	83
Line-5	40.8	87.4	0.466	1.144	32.0	75.5	0.435	1.360	25	85
Line-6	31.4	36.6	0.340	1.085	24.5	32.0	0.326	1.331	27	90
Hor.ot.	42.7	90.6	0.522	1.223	35.5	81.0	0.493	1.388	35	115
Esk-855	44.3	94.7	0.534	1.206	37.0	84.0	0.481	1.341	32	112
Mean	31.2	64.5	0.384	1.274	25.9	56.6	0.351	1.350	28	86

Table 2. Mineral and vitamin compositions of the bean samples grown at two locations*

	Fe	Cu	Zn	Mn	P	K	Ca	Mg	Na	Thiam.	Ribof.
	LOCATION : YENİKENT										
Line-1	7.58	1.47	4.16	3.26	262.4	1488	142.3	141.2	76.0	0.744	0.150
Line-2	8.87	3.42	4.96	4.64	271.8	1495	152.3	154.1	75.7	0.654	0.147
Line-3	8.51	2.01	4.02	2.93	252.2	1494	134.0	138.9	93.0	0.510	0.154
Line-4	6.96	1.43	3.58	1.84	286.1	1490	123.9	132.7	89.9	0.382	0.156
Line-5	8.08	1.13	3.42	2.22	358.4	1406	156.5	137.5	54.4	0.436	0.132
Line-6	7.82	1.49	3.66	2.11	346.0	1451	136.0	135.2	74.0	0.454	0.134
Hor.ot.	8.15	1.06	3.27	2.50	372.0	1521	141.5	134.4	75.5	0.422	0.163
Esk-855	8.48	1.27	3.46	2.90	310.0	1560	146.1	132.8	79.9	0.395	0.140
Mean	8.06	1.66	3.82	2.80	307.4	1488	141.6	138.7	77.8	0.500	0.147
	LOCATION : MERİÇ										
Line-1	7.86	1.29	6.38	1.83	366.4	1486	130.0	136.2	62.3	0.432	0.128
Line-2	7.75	1.62	5.92	2.65	462.7	1475	145.9	137.5	82.3	0.372	0.145
Line-3	7.92	1.67	6.21	1.72	410.0	1487	135.7	136.0	78.7	0.681	0.171
Line-4	7.31	1.26	5.84	1.69	506.5	1495	139.7	132.9	56.6	0.772	0.175
Line-5	6.82	0.90	5.22	1.62	492.1	1536	122.8	132.4	42.6	0.692	0.163
Line-6	7.02	1.15	5.34	1.78	474.8	1490	114.4	130.1	81.4	0.763	0.152
Hor.ot.	6.31	1.12	5.42	1.75	416.4	1488	129.7	132.2	61.6	0.509	0.163
Esk-855	6.12	0.96	4.98	1.88	320.0	1447	135.1	132.3	69.6	0.554	0.154
Mean	7.14	1.25	5.66	1.87	431.1	1488	131.7	133.7	66.9	0.597	0.156

* All values are given as mg/100 g

(dry and wet seed weight, swelling capacity and index, hydration capacity, dry and wet volume, dry and wet cooking time) which are found to be influenced primarily by genotype can be used as selection criteria in breeding programs. The tests which show significant correlations with cooking time can also be used as

Table 3. Correlative relations between cooking time and other quality criterias and mineral contents

	Cooking Time	
	Wet	Dry
Dry weight	0.498 *	0.861 **
Wet weight	0.549 *	0.770 **
Hydration capacity	0.588 *	0.888 **
Dry volume	0.548 *	0.890 **
Wet volume	0.563 *	0.782 **
Swelling capacity	0.568 *	0.886 **
Swelling index	0.504 *	0.553 *
Fe	-0.433	-0.511 *
Cu	-0.433	-0.634 **
Mg	-0.205	-0.507 *

simple prediction tests in breeding programs. The present study aims to give a general idea of the quality and composition of bean genotypes grown in Turkey as well as to investigate the effects of growing location and genotype on these criteria and the relationship between the cooking time and other quality criteria. However, the effects of growing location on and genotype on the quality and composition of dry beans must be investigated in a more detailed study, including the use of more growing locations and more bean genotypes. The effects of storage conditions should also be considered in order to prevent the adverse effects of hardening phenomenon.

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