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Assessment of Processing Quality Traits of Different Potato Genotypes in Konya

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ABSTRACT

This study aimed to determine the potato breeding lines that show superior processing quality traits and can be candidate variety by selection. The study was conducted according to The Randomized Plots Trial Design with four replications in 2019 and 2020. In the study, 26 potato breeding lines developed by Selcuk University, Faculty of Agriculture, Department of Field Crops, and 4 registered varieties as plant material were used in the two years. The varieties and lines were harvested in the fields and then the genotypes were evaluated according to processing quality traits. In the study; dry matter ratio (%), chips yield (%), French fries yield (%), chips, and French fries color (L*, b*) parameters were examined. Dry matter ratio, chips yield and French fries yield, and chips and French fries color values were found important statistically in terms of years, genotypes, year x genotype interactions. Values of chips and French fries color were varied from only genotypes averages. According to two years average, results showed large variations for examined parameters; dry matter ratio changed between 16.8-20.9 %, chips yield was 34.1-51.0 %, French fries yield was 30.7-44.9 %, chips color values (L*, b*) were 19.4-67.1, 8-44 and French fries color values (L*, b*) were 11.4-71.5, 13.5-58.2, respectively.

1. Introduction

Potatoes are mainly perennial plants in temperate climates. However, the potato plant adapted to the annual development period in the places where its culture was carried out and physiologically acquired an annual feature. Currently, it is located at an altitude of 4000 meters above sea level. It is spread over a very large area from the 70th North latitude to the 50th Southern latitude and has a close adaptation to cereals. *Tuberosum* groups decrease to sea level as they approach the adaptation limits, and rise to an altitude of 1500-2000 meters as they approach the Equator, as in the Andes since it can form tubers at certain degrees. Although it is spread over a very wide area, it also presents many differences in cultivation technique and post-harvest processes (Sencar et al., 1994; Caliskan, 2001).

Potatoes, which are cultivated worldwide and included in the family of *Solanaceae*, are botanically classified as *Solanum tuberosum* subsp *tuberosum*. There are 95 species belonging to the *Solanaceae family*. In addition to the potato plant; *Solanum* species, which include tomatoes, peppers, eggplants, tobacco, and some ornamental plants, economically represent the most important and largest group. There are about 2000 types of these species, and about 150 are tuberous species. These include polyploid series from diploid (2x) to hexaploid (6x) (75 % of them are diploid) (Sleper and Poehlman, 2006; Bradeen et al., 2011).

A potato tuber contains approximately 13-37 % dry matter, 13-30 % carbohydrates, 0.7-4.6 % protein, 0.02-0.96 % lipids, and about 0.44 % ash (Salunkhe et al., 1991). In addition, it also contains important dietary sources such as; potassium, fiber, vitamins C and B6, essential amino acid, and other elements. For example, in a large potato tuber (≌ 299 g) There are 278 calories (1164 kJ). It contains vitamins E as well as minerals K, Mg, Ca, Mn, P, Na, and Fe in low amounts (Bradeen et al., 2011; Anonymous, 2021a).

It is possible to divide the consumption market into two cooking and industrial. There are certain criteria regarding which potato variety can be considered an industrial potato. These can be listed as factors such as the specific gravity of the tuber, dry matter ratio, the amount of reduced sugar, the starch ratio (only for starch type varieties), and the color and external characteristics of the tuber. Potatoes contain 15-25 % of dry matter. For industrial-type potatoes, the dry matter ratio should be 20 % and higher, the starch ratio should be 13 % and higher, and the specific gravity should be 1.080 and higher (Kirkman, 2007; Gunel et al., 2010; Haque et al., 2018).

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In recent years, the development of potato varieties in our country has gained momentum. As a result, today there are 191 registered varieties of potatoes. Some of our national varieties were improved by; Ege University Faculty of Agriculture (Nif), Doga Tohumculuk (Kutup, Zirve, Doruk, İlkmor, Bahar, Kaya, Volkan, Yaprak, Yediveren, Yaldız, Maden, Ayaz, Yankı), Gazi-osmanpasa University Faculty of Agriculture (Basciftlik Beyazi), Nigde Potato Research Institute Directorate (Fatih, Nahita, Nam, Unlenen, Onaran 2015, Cagli, Muratbey, Leventbey, Saruhan, Nigsah), İnan Meijer Seed Growing (Sultan Ecem, Sultan Nur), Yuksel Seed Growing (Asya, Soylu, Cevher, Demet, Maraton) and brought in our country (Anonymous, 2021b).

It is necessary to free the tuber seed cultivation from being dependent on imports and support the high-level (Super Elite, Pre-Elite, etc.) seed cultivation system in order to domestic potato production to reach the desired level. Although there is still no incentive system in force in this regard, some companies have turned to the production of starting materials with tissue culture in recent years. It takes 5-6 years for the seeds to reach the producer with this process, it is necessary to implement a special incentive system for this process (Caliskan et al., 2020).

This study aimed to evaluate certain quality parameters of some trade registered potato varieties and lines developed by Associate Professor Rahim Ada show superior processing quality traits and can be candidate variety by selection. It is important to collect and define data on quality parameters in order to develop varieties with superior characteristics in breeding studies. It is necessary to reveal the characteristics of the potato lines in the selection process of breeding programs for the development of domestic potato varieties.

2. Materials and Methods

The breeding lines were selected as crossbreed seeds that were developed to 5th field generation by selection. The information about these lines and varieties are shown in the Table 1.

The study was conducted according to "Randomized Complete Blocks Design" with four replications between 2019 and 2020. The field studies were conducted at Selcuk University Faculty of Agriculture Abdulkadir Akcin Trial Field in Konya. In 2019, planting was done manually in the plant beds that were determined by markers as 70 cm x 30 cm (row spacing – intra-row) on 30th April 2019. In 2020, experiment were done by potato planting machine on 20th April 2020. The each parcel was organized as 3 meters long by making 2 rows for each genotype in the experiment. All genotypes were produced and harvested in Konya during the 2019-2020 vegetation periods.

Table 1
Information on potato varieties and breeding lines used in the study

GENOTYPES	USAGE
AFAGR6	Chips
AFAGR7	Chips
AFAGR9	Chips
AFAGRB	Chips
AFXBRO3	Combine Type*
AFHER3	Cooking
AFLA5	French Fry
AFLA11	French Fry
ELAF6	Cooking
ELAF7	Cooking
GRANAFA	Cooking
HERAF6	Chips
LOLA1	French Fry
POMAFA	French Fry
POMT2/5	French Fry
T1AGR1	Cooking
T1AGR13	Cooking
T3AG2	Cooking
T3AG4	Cooking
T3LA3	Combine Type
T3LA7	Combine Type
T3LA10	Combine Type
T3POM2	Combine Type
T3POM6	Combine Type
T3POM9	Combine Type
T7POM1	Combine Type
DİDO	Cooking
HERMES	Chips -Industry
RUMBA	Cooking
VAN GOGH	French Fry

*Cooking-Chips-French Fry

According to Caliskan (2001), the dry matter ratio in the tuber samples taken from each parcel after harvesting, the productivities of chips and French fry according to the method indicated by Senol (1973), and frying color scales with using the Minolta Chroma Meter (Minolta Corp., Ramsey, NJ). have determined.

In the study; dry matter ratio (%), chips yield (%), French fries yield (%), chips, and French fries color (L*, b*) parameters were examined.

The data were analyzed using the technique of analysis of variance (JUMP) and treatment means were separated by Least Significant Differences (LSD) a 1 % probability level by using MSTAT-C as described by Nissen (1989).

3. Results and Discussion

The variance sources and their statistical significance are shown in Table 2 for the dry matter ratio (%), chips yield (%), French fries yield (%), chips, and French fries color (L*, b*) parameters.

Table 2
Results of variance analysis of some quality parameters of 30 potato genotypes in the experiment

Source of Variation	df	Means square		
		Dry matter ratio (%)	Chips yield (%)	French fries yield (%)
Years	1	1,05**	539,40**	13,21**
Replication [Y]	29	9,30	186,97	138,61
Genotypes	6	0,07**	7,44**	1,90**
Y x G	29	1,22**	78,95**	61,63**
Error	174	0,17	3,52	2,85

Source of Variation	df	Chips L value	Chips b* value	French fries L* value	French fries L value
Years	1	51,52	14,46	134,70	9,36
Replication [Y]	29	1042,85	522,30	1409,32	781,66
Genotypes	6	135,28**	26,86**	25,20**	40,05**
Y x G	29	87,51	60,06	94,19	80,08
Error	174	119,88	100,43	69,37	83,89

*P < 0.05, **P < 0.01

The dry matter content is closely related to the starch content. In addition to the genetic structure of the tubers, the ecological conditions in which they are grown and the cultural practices in the field affect the dry matter and its distribution. On the contrary, there is a higher dry matter ratio in late maturation tubers and tubers grown at high altitudes. Most importantly, the difference in the tubers quality directly affects the dry matters proportion (Yilmaz and Karan, 2011). In addition, the content of dry matter in the tuber varies depending on certain areas of the tuber. While there is a smaller amount of dry matter in the center of the tuber, the more dry matter ratio is determined towards the ends of the tuber. In this case, the dry matter ratio is the highest in the stolon parts, and this dry matter change on the tuber fluctuates by the 7 % (Gaze et al., 1998; Pringle et al., 2009).

The values procured in terms of the dry matter ratio, which is one of the most important quality criteria of potato tubers, displayed significant differences (P <0.01) according to years and genotypes (Table 2). The average dry matter ratios of the genotypes varied between 16.7 % and 20.9 %. The highest dry matter content was recorded in the T3LA7 line with 20.9 %, and the lowest ratio was detected in the T1AGR1 line with 16.7 %. Differences in dry matter ratios of genotypes were found over the years (Table 3).

Dry matters of industrial genotypes turned out to be higher than edible types. Thus, the desired dry matter range for industrial potatoes is higher than 20 %, and the desired reduced sugar content range is lower than 0.1 % (Marwaha et al., 2010).

Our findings indicate that the dry matter ratio is influenced by environmental factors as well as genetic structure, and generally industrial varieties have a higher dry matter ratio. This statement showed similarities with the findings of Sanli and Karadogan (2012), Karan (2013), Arioglu et al. (2018), and Bulbul (2018) Naeem and Caliskan (2020).

High dry matter content, less oil absorption of chips, crispy consistency in the mouth, lower reduced sugar and light frying color are bunch of the defining quality criteria in industrial potatoes (de Freitas et al., 2006). There is also a relationship between the dry matter content and the frying efficiency and frying color. The high dry matter content increases the productivity of chips, provides a crispy consistency in the mouth and less oil absorption during frying process(Pedreschi et al., 2005; Rommens et al., 2010). In our study, both the chips and finger potatoes productivities were found to be high in varieties with high dry matter ratios. Hence, high dry matter ratios as well as high frying efficiency were detected in lines such as T3LA7, T3POM2, T3POM6, T3POM9, AFLA5, LOLA1, T3LA10 (Table 3).

The main criteria for the chips and French fry sector can be listed as follows; After frying, there should be not problems in sugar content, mouthfeel, aftertaste, crispness, inner color and texture, it should be easily peeled and resistant to storage (Guenthner, 2020). In addition, the content of dry matter is one of the most important factors affecting the texture of potatoes. The frying efficiency of chips and finger potatoes is mainly related to their dry matter content (O'Donoghue et al., 1996).

Potato varieties are classified according to the quality characteristics of the tuber like special cooking and processing properties, such as boiled, French fry. It is decided whether a variety is a potato chip or a finger potato by considering its many properties. The tuber appearance of French fry is long and thin, this the length can be up to 10 cm. For potato chips, the type of tuber should be round (Jansen et al., 2001; Anonymous, 2021c).

Potatoes with a high starch content are preferred because they absorb less fat during frying (Stark, 2003). The oil content and texture of potato chips are also influenced by the frying temperature and the type of oil used for frying (Kita et al., 2007).

Table 3
Means of Dry matter ratio (%), chips yield (%), French fries yield (%) of 30 potato genotypes evaluated under Konya location in 2019-2020 years.

Genotypes	Dry matter ratio (%)			Chips yield (%)			French fries yield (%)		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
AFAGR 6	20,4 a-d	19,5 p-h	19,9 d-h	46,3 h-n	31,4 z	38,9 j-l	46,6 c-f	42,4 ı-p	44,5 c-g
AFAGR7	19,3 g-ı	18,9 h-l	19,1 ı-l	38,4 u-w	37,7 u-x	38,1 kl	38,9 q-v	36,0 v-y	37,5 mn
AFAGR9	20,3 b-e	18,4 j-l	19,3ı-k	45,1 ı-q	46,2 h-n	45,7 d-g	47,1 c-e	38,1 s-w	42,6 g-j
AFAGRB	21,0 ab	19,6 e-h	20,3 b-e	54,9 ab	47,0 f-l	51,0 a	51,0 a	42,2 j-p	46,6 bc
AFXBRO3	18,4 j-l	18,9 h-l	18,6 l-m	38,1 u-w	46,3 h-m	42,2 hı	41,5 m-r	34,6 x-z	38,1 m
AFHER3	17,5 mn	19,3 g-ı	18,4 n	46,1 h-o	34,5 x-z	40,3 ı-k	46,3 c-g	31,8 z	39,1 k-m
AFLA5	20,5 a-c	20,3 b-e	20,4 a-d	46,9 g-m	54,5 ab	50,7 a	40,9 o-t	46,3 c-g	43,6 e-ı
AFLA11	19,0 g-k	19,1 g-j	19,0 k-m	48,7 d-h	50,4 c-f	49,5 ab	44,7 c-l	44,2 e-n	44,5 c-g
ELAF6	19,5 f-h	19,6 e-h	19,5 g-k	45,7 h-p	53,7 a-c	49,7 ab	44,2 e-n	45,5 c-ı	44,9 c-f
ELGAF7	20,3 b-e	19,4 f-ı	19,8 e-ı	40,5 s-u	51,6 b-d	46,0 d-f	44,4 d-m	50,7 ab	47,5 ab
GRANAFA	19,6 e-h	17,4 no	18,5 mn	47,6 e-k	46,3 h-n	47,0 c-e	45,3 c-j	46,4 c-g	45,9 b-d
HERAF6	18,3 kl	18,3 kl	18,3 n	44,3 k-r	54,6 ab	49,4 a-c	47,6 bc	51,2 a	49,4 a
LOLA1	20,8 a-c	20,4 a-d	20,6 ab	47,9 e-j	53,2 a-c	50,5 a	42,0 k-q	45,5 c-ı	43,7 e-ı
POMAFA	17,4 no	17,3 no	17,4 o	44,0 l-v	43,1 n-s	43,5 gh	47,5 cd	38,4 r-v	43,0 f-j
POMT2/5	18,9 h-l	19,4 f-ı	19,1 j-l	35,2 w-y	46,4 h-v	40,8 ıj	40,5 o-u	44,9 c-k	42,7 g-j
T1AGR1	16,2 p	17,1 no	16,7 p	37,9 u-x	42,5 p-s	40,2 ı-k	40,7 o-t	41,2 n-s	41,0 j-l
T1AGR13	19,4 f-ı	19,0 g-k	19,2 t-k	44,5 j-r	43,5 n-s	44,0 f-h	33,6 b-z	38,0 t-w	35,8 n
T3AG2	18,4 j-l	18,4 j-l	18,4 n	35,0 w-y	43,4 n-s	39,2 j-l	27,3 z	37,5 u-x	32,4 o
T3AG4	18,5 j-l	18,7 ı-l	18,6 l-n	35,9 v-y	38,9 t-u	37,4 l	30,8 z	30,5 z	30,7 o
T3LA3	18,2 lm	18,3 kl	18,3 n	42,2 q-t	45,3 h-q	43,7 f-h	42,0 k-q	41,2 n-s	41,6 ı-j
T3LA7	21,1 a	20,6 a-c	20,9 a	44,9 ı-q	50,3 c-g	47,6 b-d	41,3 mr	43,6 f-o	42,4 g-j
T3LA10	20,3 b-e	20,5 a-c	20,4 a-d	45,0 ı-q	55,9 a	50,4 a	41,5 m-r	45,3 c-j	43,4 f-ı
T3POM2	19,4 f-ı	19,4 f-ı	19,4 h-k	35,5 v-y	42,7 o-s	39,1 j-l	35,2 w-y	42,7 h-p	38,9 lm
T3POM6	20,1 c-f	20,1 c-f	20,1 b-f	41,9 q-t	46,1 h-o	44,0 f-h	46,1 c-g	46,4 c-g	46,2 b-d
T3POM9	19,7 d-g	20,3 b-e	20,0 c-g	45,1 ı-q	50,5 c-e	47,8 b-d	42,6 h-p	41,7 l-q	42,1 h-j
T7POM1	17,0 no	16,7 op	16,8 p	35,0 w-y	33,2 yz	34,1 m	44,1 e-n	41,5 m-r	42,8 f-j
DİDO	18,4 j-l	18,5 j-l	18,4 n	36,2 b-y	41,1 r-u	38,6 j-l	43,5 f-p	44,8 c-l	44,2 d-h
HERMES	19,3 g-ı	19,6 e-h	19,4 h-k	48,2 d-ı	53,0 a-c	50,6 a	45,7 c-h	45,5 c-ı	45,6 b-e
RUMBA	20,5 a-c	20,5 a-c	20,5 a-c	43,1 n-s	47,0 f-l	45,0 e-g	44,3 e-n	37,9 ı-n	41,1 j-k
VAN GOGH	19,7 d-g	19,6 e-h	19,6 f-j	45,9 h-p	45,9 h-p	45,9 d-g	43,3 g-p	40,4 p-u	41,8 ıj
Mean	19,2 a	19,1 b	19,2	42,9 b	45,9 a	44,4	42,3 a	41,9 b	42,1
	$Lsd_{genotype\ (0.01)} = 0,5$			$Lsd_{genotype\ (0.01)} = 2,4$			$Lsd_{genotype\ (0.01)} = 2,2$		
	$Lsd_{year\ x\ genotype\ (0.01)} = 0,8$			$Lsd_{year\ x\ genotype\ (0.01)} = 3,5$			$Lsd_{year\ x\ genotype\ (0.01)} = 3,1$		

The significant (P <0.01) differences were determined among the chips productivities of the potato genotypes used in the study according to the years and genotypes (Table 2). Frying productivities were determined above 50 % in lines of AFLA5 50,7 (%), LOLA1 (50,5 %), T3LA10 (50,4 %), and varieties of Hermes (50,6 %) in the same statistical group. It is expected that the productivities of chips will also vary depending on the alteration in the dry matter ratios of the genotypes over the years (Table 3). The quality of chips is affected by the size of the tuber, its shape, eye depth, specific gravity, dry matter and reduced sugar levels. These factors depend on cultural practices, environmental conditions, and genotype. However, the genetic component has the strongest effect, since the properties are inherited. In a study conducted by

(Abong et al., 2012). Karadogan (1994a), it was reported that there was a positive relationship among the potato chips; they stated a negative relationship among the protein ratios and oil absorption ratios. As a matter of fact, frying efficiency of these genotypes with high dry matter ratio was also found to be high (Table 2). This is due to the fact that the water loss during frying is less in tubers with a high dry matter ratio (Sanli and Karadogan, 2012).

The significant (P <0.01) differences were determined between the French fry productivities of the potato genotypes used in the study compared to the years and genotypes (Table 2). French fry productivity is related to the dry matter ratio, and it productivities of genotypes with a high dry matter ratio are also high (Karadogan, 1994a). Also in this study, French fry productivities of genotypes with a high dry matter content were high (HERAF6 ‘ 49.4%’, dry matter average ‘18.3%’; ELAF7 ‘ 47.5%’, dry matter average ‘19.8%’) (Table 3).

Table 4
Means of some quality parameters of 30 potato genotypes evaluated under Konya location in 2019-2020 years.

Genotypes	Chips L* value			Chips b* value		
	2019	2020	Mean	2019	2020	Mean
AFAGR 6	39,2	38,0	38,6 e-h	9,4	20,3	14,9 ı-k
AFAGR7	29,6	31,9	30,7 g-ı	36,3	33,6	34,9 a-d
AFAGR9	36,3	37,7	37,0 e-h	27,4	26,7	27,0 b-ı
AFAGRB	46,9	46,1	46,5 b-f	17,6	19,4	18,5 e-k
AFXBRO3	58,4	59,4	58,9 ab	8,6	7,4	8,0 k
AFHER3	60,3	68,5	64,4 a	13,3	13,1	13,2 jk
AFLA5	40,4	36,1	38,3 e-h	24,1	27,7	25,9 c-j
AFLA11	16,8	22,1	19,4 ı	44,0	45,6	44,8 a
ELAF6	41,0	39,4	40,2 e-h	24,6	31,5	28,1 b-g
ELGAF7	50,7	66,9	58,8 a-c	31,6	28,5	30,0 b-f
GRANAFA	33,4	29,3	31,3 g-ı	37,2	38,3	37,8 a-c
HERAF6	42,2	46,7	44,5 d-g	21,9	17,2	19,5 e-k
LOLA1	69,4	64,8	67,1 a	26,2	25,6	25,9 c-j
POMAFA	44,8	39,8	42,3 e-g	14,9	20,2	17,6 f-k
POMT2/5	37,5	40,5	39,0 e-h	18,8	14,1	16,4 g-k
T1AGR1	38,9	36,1	37,5 e-h	31,2	21,6	26,4 c-ı
T1AGR13	43,2	46,0	44,6 c-g	16,5	13,6	15,0 h-k
T3AG2	30,7	30,6	30,6 g-ı	26,2	26,6	26,4 c-ı
T3AG4	44,3	43,1	43,7 d-g	26,3	20,6	23,5 d-j
T3LA3	66,7	48,8	57,7 a-d	26,7	30,7	28,7 b-g
T3LA7	62,7	58,4	60,5 ab	22,9	34,1	28,5 b-g
T3LA10	39,4	40,0	39,7 e-h	23,6	22,6	23,1 d-j
T3POM2	39,5	39,0	39,2 e-h	25,6	27,7	26,6 c-j
T3POM6	41,8	55,2	48,5 b-e	26,2	22,1	24,2 d-j
T3POM9	31,9	34,5	33,2 f-ı	32,7	29,0	30,8 b-e
T7POM1	28,1	41,3	34,7 e-h	35,6	23,0	29,3 b-g
DİDO	43,2	50,6	46,9 b-f	24,2	14,2	19,2 e-k
HERMES	28,7	25,5	27,1 hı	37,7	42,1	39,9 ab
RUMBA	35,2	36,9	36,0 e-h	26,8	29,2	28,0 b-h
VAN GOGH	38,7	34,2	36,4 e-h	23,0	20,0	21,5 e-j
Mean	42,0	42,9	42,4	25,4	24,9	25,1
	Lsd $_{genotype\ (0.01)}$ = 14,3			Lsd $_{genotype\ (0.01)}$ = 13,1		

Browning after frying occurs due to both the reduced sugar content and the interaction of sucrose with the amino acid (Shallenberger et al., 1959). The type of oil used during frying, frying temperature, frying time, fried potato variety affect the color change (Pringle et al., 2009). Many methods are used for color determination after frying. Visual evaluation can be performed by comparing the graphs with the color scales determined by various organizations. This method is cheap, fast, but subjective. These tables are available for French fries (Munsell USDA Frozen French Fries Standard, X-Rite Right On Color) and potato chips (Color Standards Reference Table for Potato Chips, Snack Food Association) (Liu et al., 2009; Pringle et al., 2009). The color scales range from white flesh color to yellow flesh color. Some scales have a large pool of colors ranging from red and purple. Yellow flesh color divided into subgroups such as light yellow, yellow and dark yellow. The yellow color has a higher preference rate in the consumption network. It is in demand because it has a smooth, creamy and sometimes waxy appearance inside when cooked. Tubers that have a white flesh color are usually small-medium sized tubers. Potatoes with low sugar content have a slightly sweetish aroma. The varieties in this scope are suitable to be fried as chips and as finger potatoes (Bond, 2014; Anonymous, 2021c).

Expensive methods that give a clear result can also be used. Fried samples can be determined by wavelengths of the light directed to it via some devices. For example, it can be measured using a color meter such as the Minolta Chroma Meter (Minolta Corp., Ramsey, NJ). The device is calibrated according to the standard white (Minolta) reference plate, the values of L* (whiteness), a* (greenness) and b* (yellowness) can be determined for each sample and it can be evaluated based on the data procured as a result of direct application to the potato surface (Nourian et al., 2003; Pringle et al., 2009).

Table 5
Means of some quality parameters of 30 potato genotypes evaluated under Konya location in 2019-2020 years.

Genotypes	French fries L* value			French fries b* value		
	2019	2020	Mean	2019	2020	Mean
AFAGR 6	38,8	31,2	35,0 e-j	18,1	29,1	23,6 d-g
AFAGR7	33,6	36,4	35,0 e-j	28,1	24,5	26,3 c-g
AFAGR9	37,8	38,5	38,1 d-ı	23,0	23,8	23,4 d-g
AFAGRB	38,9	39,6	39,2 d-ı	25,4	28,2	26,8 c-g
AFXBRO3	42,1	35,2	38,7 d-ı	18,4	24,9	21,6 e-g
AFHER3	46,8	39,1	43,0 d-h	20,4	21,1	20,7 e-g
AFLA5	28,5	31,9	30,2 h-k	35,7	32,5	34,1 b-f
AFLA11	21,6	18,4	20,0 j-l	46,7	48,7	47,7 ab
ELAF6	25,6	27,1	26,4 ı-l	40,9	37,5	39,2 b-d
ELGAF7	50,5	54,0	52,3 b-d	17,1	24,4	20,7 e-g
GRANAFA	10,5	12,3	11,4 l	58,8	57,6	58,2 a
HERAF6	45,8	40,9	43,4 d-h	25,2	22,9	24,0 d-g
LOLA1	72,7	70,3	71,5 a	22,4	31,6	27,0 c-g
POMAFA	57,4	40,9	49,1 c-e	17,8	21,5	19,6 e-g
POMT2/5	13,8	24,5	19,2 kl	53,3	41,9	47,6 ab
T1AGR1	27,1	38,0	32,6 f-k	32,2	26,1	29,1 c-g
T1AGR13	47,3	45,2	46,3 d-g	17,3	19,4	18,3 fg
T3AG2	33,9	38,5	36,2 e-ı	32,0	32,9	32,4 b-f
T3AG4	29,7	35,7	32,7 f-k	31,7	33,6	32,6 b-f
T3LA3	69,7	53,7	61,7 a-c	34,3	14,4	24,3 d-g
T3LA7	68,2	66,0	67,1 ab	37,8	29,5	33,7 b-f
T3LA10	32,0	30,6	31,3 g-k	33,4	33,8	33,6 b-f
T3POM2	29,4	35,3	32,4 f-k	34,7	28,6	31,6 b-f
T3POM6	40,1	41,8	41,0 d-ı	23,7	23,5	23,6 d-g
T3POM9	45,3	43,3	44,3 d-h	23,0	20,5	21,7 e-g
T7POM1	30,1	28,4	29,2 h-k	35,3	36,0	35,6 b-e
DİDO	34,3	30,0	32,1 f-k	32,1	35,6	33,8 b-f
HERMES	34,1	18,0	26,0 ı-l	38,4	47,1	42,7 a-c
RUMBA	46,2	48,2	47,2 c-f	13,9	13,2	13,5 g
VAN GOGH	38,8	32,9	35,9 e-ı	29,2	24,2	26,7 c-g
Mean	39,0	37,5	38,3	30,0	29,6	29,8
	$Lsd_{genotype (0.01)}$ = 15,3			$Lsd_{genotype (0.01)}$ = 16,9		

L* indicates brightness values and b* indicates yellowness values in the color values of the fried samples (Soares et al., 2016). The color values of chips and French fries varied according to the genotype and significant (P <0.01) differences were found. However, the values difference in years and year x genotype interactions was found to be statistically insignificant (Table 2). The average L* brightness values of the chips procured as a result of frying the genotypes differed significantly, the brightest chips L* values were detected in the LOLA1 line with 67.1 and in the AFHER3 line with and 64.4 (Table 4). The dry matter ratios in these lines were determined more than 18 % (Table 3). In the French fry values, the LOLA1 line represented the highest L* brightness value with 71.5 (Table 5). Since tubers with low dry matter ratios will absorb more oil during frying, their L* brightness values also decrease with the same ratio (Ozcan, 2019).

When the b* yellowness values of tubers were examined, significant (P <0.01) differences were detected between the genotypes. According to the b* yellowness values of the tubers, the highest value was determined in the AFLA11 line (44.8) (Table 4). Finger potato b* yellowness values were recorded on the GRANAFA line with 58.2.

It is desirable that the potatoes that will be used as industrial potatoes, French fries (fried potatoes) and potatoes used for making chips have a high productivity. In addition, the fact that they absorb less oil during frying process is a desirable property in terms of both health and low cost. The most important property is the color of chips and French fries. It is desirable that the chips and French fries have a golden-yellow and uniform color (Karadogan, 1994b).

4. Coclusion

In our two-year study, lines and standard varieties brought by selection up to the 5th field generation in our potato variety breeding program with high tuber productivities were used and evaluated in terms of quality parameters. Tuber productivity and productivity components are the most important breeding goals in potato breeding studies. In addition, it is important to work with many lines in industrial and edible potato breeding studies and to examine the quality components and agricultural characteristics.

This research aims to determine the promising potato lines by examining the dry matter ratio, frying efficiency, and color scales of the potato lines developed by

Associate Professor Rahim Ada. When the research results were interpreted, T3LA7, T3POM2, T3POM6, T3POM9, AFLA5, LOLA1, T3LA10 lines were determined as ümitvar potato lines in terms of dry matter ratio, frying efficiency and color values.

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