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Determination of Pomological and Chemical Properties of Some Medlar (*Mespilus germanica* L.) Genotypes

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Abstract

In this study, some phenological, pomological, and chemical properties of 11 medlar genotypes, selected from Tokat province, were investigated. They were affected by genotypes, years and analyzing stages. The first blossoming was started between at the end of April and in the beginning of May. Average fruit weight was ranged between 17,71 g -32.46 g in 2011 and 15,99 g – 37.54 g in 2012. Fruit diameter was determined around 21,07 mm -41.05 mm in 2011 and 17,49 mm – 43,63 mm in 2012. Fruit length was found out 18,25 mm -38,27 mm in 2011 and 14,96 mm – 35,68 mm in 2012. Total soluble solid was recorded 14.10%-27.30% at tree maturity stage and 13.80%-20.50% during consuming stage. Total dry matter was determined between 27.34% - 44.11%. Total acidity was between 4.25%-8.94% at tree maturity and 2.80%-7.24% during consuming stage. Vitamin C was observed between 8.00-30.00 mg/100 g at tree maturity stage, and 26.67-6.40 mg/100 g in the consuming stage. Total phenolic compounds were found out between 92.05-10.64 mg/100 g at tree maturity stage and n 45,30-10,35 mg/100 g during consuming stage.
According to pomological properties, 60NA001, 60NT001, and 60NA003 genotypes are better than others. Erbaa location genotypes (60EK004, 60EK010, 60EK014) had better chemical properties than other locations.

Keywords -
Medlar (Mespilus germanica L.), Tokat province, phenological, pomological, and chemical properties

1. Introduction

Medlar (*Mespilus germanica*) belongs to Rosaceae family, and it is called ‘Döngel’ or ‘Beşbıyık’ in Turkey, ‘Ezgil’ in Azerbaijan, ‘Bushmala’ in Georgia and ‘German’ or ‘Germanic Medlar’ in the most of European countries [1].

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Its tree is generally 3-5 m tall, but it may reach nearly 8 meters. It is self-fertile and long-lived tree. It lives approximately 30-50 years. There is 100 year old trees in UK as well. The flowers are white-pink and hermaphrodite. Flower buds are formed in May-June, and each bud has one flower. Fruit shape may be variable.

Fruits are uneatable during tree maturity stage because of tannin content. It becomes eatable when the skin color becomes chocolate brown. Medlar contains organic acids, sugars, pectin, vitamin C, and small amounts of vitamin A [2]. It is commonly grown in Marmara, Western Karadeniz and Mediterranean regions in Turkey [3].

Medlar production is approximately 4134 tons in Turkey and 51 tons in Tokat. 'Royal', 'Nottingham' and 'Dutch' varieties are grown in commercial producing countries like Germany and Netherland [1], and ‘Istanbul’, ‘Italian’ and ' Akcakoca 77' varieties are grown in Turkey. In this study, the medlar population were determined in Tokat province, and selected genotypes were investigated for developing new varieties.

2.2. Methods

Selection of Genotypes

At first, disease free and lush medlar trees were selected and grouped as dwarf and semi-dwarf. Then, genotypes were observed in detail, and compared to fruit size, tree yield, total soluble solid, kernel weight/fruit weight ratio. The best performed genotypes were planted in the genetic resource plots.

Phenological Properties
The beginning of blooming (5%), full blooming (50%), and end of blooming (90%) were observed.

Pomological Properties
Fruit weight (g) and fruit sizes (diameter and length) were measured on 20 fruits.

Chemical Properties
Fruits were ground with food blender. pH, total acidity(g/l), total soluble solid (TSS), vitamin C(mg/100 g), total dry matter content (%) and total phenol compounds (mg/100 g) were analyzed.

3. Results and Discussion

Phenological Properties
The blooming dates were significantly affected by locations, years, and genotypes. Erbaa and Niksar district genotypes’ the first blooming date was a week earlier than Pazar district and Tokat locations. According to years, the first blooming date was on 7^{th}-15^{th} of May, 2011. It was a week earlier in 2012 than 2011. According to genotypes, 60EK004, 60EK014, and 60EK010 genotypes were bloomed on 26^{th} of April in 2012. Their blooming was delayed on 7^{th} of May in 2011. Full blooming date was a week later than the first blooming date, and end of blooming date was a week later than the full blooming date (Table 1). Differences between locations and years can be originated from climatic conditions (altitude, temperature, rainfall etc.). Differences among genotypes are based on

genotypic characteristics. This is in agreement with Glew at al. (2003). Their study showed that the blossoms were considered to be in full bloom on 8 May 2000 [4]. Similarly, Ayaz et. al. (2008) reported that full bloom of the medlar was occurred on 10 May 2003 [5].

Table 1. Blossoming dates according to genotypes, locations and years

Genotypes	Locations	Years	First blooming	Full blooming	End of blooming
60NA001	Niksar	2011 2012	10 May 30 April	18 May 03 May	24 May 10 May
60NA003	Niksar	2011 2012	10 May 30 April	18 May 03 May	24 May 10 May
60NH005	Niksar	2011 2012	07 May 28 April	11 May 01 May	16 May 08 May
60EK004	Erbaa	2011 2012	11 May 26 April	15 May 02 May	20 May 07 May
60NT001	Niksar	2011 2012	10 May 30 April	18 May 03 May	24 May 10 May
60PA058	Pazar	2011 2012	15 May 04 May	22 May 08 May	03 June 14 May
60NH002	Niksar	2011 2012	07 May 28 April	11 May 01 May	16 May 08 May
60EK014	Erbaa	2011 2012	07 May 26 April	11 May 02 May	17 May 07 May
60PM002	Pazar	2011 2012	15 May 04 May	22 May 08 May	03 June 14 May
60TH001	Turhal	2011 2012	14 May 06 May	20 May 11 May	01 June 16 May
60EK010	Erbaa	2011 2012	07 May 26 April	11 May 02 May	17 May 07 May

Pomological Properties

There were significantly differences among genotypes on average fruit weight, but there were no differences between years. Average fruit weight was ranged around 17,71 g -32.46 g in 2011 and 15,99 g – 37.54 g in 2012. The highest fruit weight was observed at 60NA001 genotype (32.46 g-37.54 g) in both years. It is followed by 60NT001 (30,25 g - 37,20 g) (Table 2). Aygun and Tascı, (2013) reported that [6] average fruit weight was 12.00 g -27.00 g) [6]. Similarly, Ozkan et al. (1997) and Bostan 2002, 2007) reported that average fruit weight was 16.51 g-32.98 g and 9.46 g-40.80 g, respectively [7,8,9]. The average fruit weight is in agreement with them.

Fruit diameter was significantly affected by genotypes, but it was no affected by years. Fruit diameter was changed around 21,07 mm -41.05 mm in 2011 and 17,49 mm – 43,63 mm in 2012. The highest fruit diameter was determined at 60NT001 genotype (41,05 mm) in 2011and 60NA001 genotype (43,63 mm) in 2012. They are followed by 60NA003 (38,70 mm) in 2011 and 60NT001 (43,59 mm) in 2012 (Table 2). This is in agreement with Aygun and Tascı (2013) and Bostan (2002, 2007). Their studies showed that fruit diameters were 23.10-42.65 mm, 31.52-42.44 mm, and 14.96-35,68 mm, respectively [6,8,9].

Table 2. Fruit weight and fruit size according to genotypes and years

Genotypes	Average Fruit weight (g)		Fruit diameter (mm)		Fruit length (mm)	
	2011	2012	2011	2012	2011	2012
60NA001	32.46±4.11	37.54±4.40	35.54±3.98	43.63±4.67	28.25±1.72	35.68±2.88
60NA003	24.87±4.35	23.67±5.06	38.70±2.99	36.07±3.44	32.94±2.85	31.65±2.41
60NH005	18.97±2.06	24.84±2.42	21.07±1.76	36.56±1.30	18.25±1.94	32.74±1.76
60EK004	17.71±2.50	15.99±2.50	33.12±3.12	31.35±2.02	29.12±2.50	28.05±1.55
60NT001	30.25±4.49	37.20±5.46	41.05±2.91	43.59±3.17	38.27±1.88	35.59±2.37
60PA058	19.31±2.26	25.04±2.43	31.18±1.63	38.79±1.48	29.30±2.54	31.58±2.25
60NH002	27.53±2.79	29.06±5.02	37.03±1.90	39.05±2.81	31.27±2.24	33.31±2.19
60EK014	20.53±2.15	16.63±2.29	21.78±2.08	17.49±2.32	19.02±1.40	14.96±1.38
60PM002	20.44±2.02	21.79±2.96	30.15±2.59	36.09±2.15	27.42±1.39	30.67±2.75
60TH001	25.13±2.44	23.20±2.93	34.76±1.78	35.94±1.81	32.38±2.95	32.26±2.63
60EK010	23.08±2.96	20.16±2.54	32.48±2.13	36.30±1.57	31.21±1.67	29.80±1.54

Fruit length was significantly varied by genotypes, while it was no changed by years. Fruit length was determined around 18,25 mm -38,27 mm in 2011 and 14,96 mm – 35,68 mm in 2012. The highest fruit length was obtained from 60NT001 genotype (38,27 mm) in 2011 and 60NA001 genotype (35,68 mm) 2012. They were followed by 60NA003 (32,94 mm) in 2011) and 60NT001 (35,59 mm) in 2012 (Table 2). This is in agreement with Hacıseferogulları et al., 2005 [10]. Their study showed that fruit length was 31.40 mm [10].

Chemical Properties

Total Soluble Solid (TSS-%), pH and Total Acidity(g/L)

TSS has been differences among genotypes, while it was no affected by years in tree maturity stage. TSS was found out between 17,06%-23.30% in the first year and 14,10% – 27.30 in the second year. The highest TSS was determined at 60EK010 genotype (23.30%) in 2011 and 60EK014 genotype (27.30%) 2012 (Table 3). TSS was slightly decreased in some genotypes, while it was slightly increased in some genotypes in consuming maturity stage (Table 3,4).

Table 3. Total soluble solid (TSS), pH and acidity values of genotypes in tree maturity stage according to genotypes and years

Genotypes	TSS (%)		pH		Total Acidity (g/L)	
	2011	2012	2011	2012	2011	2012
60NA001	20.04	21.10	3.70	3.65	6.78	7.57
60NA003	19.00	20.00	3.84	3.86	7.20	4.25
60NH005	17.06	21.06	3.50	3.95	6.28	5.91
60EK004	19.30	24.00	3.88	3.91	4.50	5.07
60NT001	17.30	20.10	3.90	3.92	6.90	6.75
60PA058	19.00	18.40	3.57	3.55	7.90	8.55
60NH002	20.30	18.00	3.65	3.72	8.20	8.94
60EK014	17.17	27.30	3.64	3.99	5.80	4.76
60PM002	17.20	21.20	3.80	3.57	6.74	6.41
60TH001	17.90	14.10	3.83	3.55	8.20	8.28
60EK010	23.30	20.70	3.92	3.54	8.30	8.83

pH was determined between 3,54-3,92 in 2011 and 3,54-3,99 in 2012 during tree maturity stage. The highest pH was found out at 60EK10 genotype (3,92) in 2011 and 60EK014

genotype (3,99) in 2012. They are followed by 60NA003 (38,70 mm) in 2011 and 60NT001 (43,59 mm) in 2012. There was no much more differences in consuming maturity stage. (Table 3,4).

Total acidity was significantly varied by genotypes, while it was no changed by years. Total acidity was determined around 4.50-8.30 g/L in 2011 and 4.25-8.94 g/L mm in 2012 during tree maturity stage. The highest total acidity was obtained from 60EK010 genotype (8,30 g/L) in 2011 and 60NH002 genotype (8,94 g/L) 2012. It was significantly decreased in the consuming stage. They were between 2.90-5.35 g/L in 2011 and 2.80-7.24 g/L in 2012 (Table 3,4). TTS is lower in the consuming stage than the tree maturity stage. It can be originated from sugar catabolism in this stage. This is in agreement with Ozkan et al., (1997). Their study showed that total soluble solid of genotypes were found out 17.00-24.00%, pH 2.89-3.22 and total acidity 5.83 -8.38 g/L [7], but there is no information about in which time they were analyzed (tree maturity stage or consuming stage). Also, Bostan et al., (2007) reported that total soluble solid, pH and total acidity were determined 12.50-25.00%, 3.70-6.15 and 1.60-20.10 g/L, respectively) [9]. Besides, Aygun and et. al., (2013) indicated that total soluble solid, pH and total acidity were obtained around 8-18%, 3.62-4.90 and the 2.3-11.9 g/L [6].

Vitamin C (mg/100 g)

Vitamin C was observed between 9,07-30.00 mg/100 g in the tree maturity stage and 6,4-26,67 in the consuming stage. The highest vitamin C was obtained from 60EK010 genotype (30,00 mg/100 g) in the tree maturity stage and 60EK004 genotype (26.67 mg/100 g) in the consuming stage (Table 5). This is in disagreement with Ercisli et al.,(2011). Their study showed that vitamin C was determined between 11.30-15.00 mg/100 g [12]. Their findings are lower than this study. It can be originated from genotypes, climatic conditions or maturity – consuming stage.

Table 4. Total soluble solid (TSS), pH and acidity values of genotypes in Consuming stage according to genotypes and years

Genotypes	TSS (%)		pH		Total Acidity (g/L)	
	2011	2012	2011	2012	2011	2012
60NA001	18.50	19.40	3.90	3.80	5.20	5.42
60NA003	18.70	19.40	3.95	3.96	5.10	4.97
60NH005	15.00	13.80	3.96	3.92	3.70	2.80
60EK004	14.20	14.30	3.98	3.87	4.20	3.68
60NT001	13.40	14.90	3.75	3.82	5.35	5.84
60PA058	17.20	17.90	3.85	3.90	5.25	3.81
60NH002	13.50	14.50	3.87	3.76	7.10	7.24
60EK014	17.00	14.70	3.92	3.97	2.90	3.55
60PM002	19.00	20.50	3.94	3.99	3.90	3.60
60TH001	15.28	15.08	3.86	4.00	5.20	2.86
60EK010	18.50	16.60	3.78	3.95	4.90	4.93

Total Dry Matter (%)

Total dry matter was analyzed only in 2012 in the tree maturity stage. It was observed between 27,34%-44,11% in the tree maturity stage. The highest total dry matter was obtained from 60EK014 genotype (44,11%) (Table 5). Total dry matter is higher than Bostan and Islam (2007) 16.40%-30.90%) [9], Ozkan et al.,(1997), 24.00%-33.00% [5], and Bostan (2002) 13.00%-26.00% [8]. It can be originated from same reasons, mentioned for vitamin C.

Total Phenolic Compounds (mg/100 g)

Total phenolic compounds were significantly varied by genotypes both tree maturity stage and consuming stage. They were determined between 232.48 -920.51 mg/100 g in the maturity stage and 103.55-453.09 mg/100 g in the consuming stage. The highest Total phenolic compounds were determined at 60NH002 genotype (920.51 mg/100 g) in the maturity stage and 60EK014 genotype (453,09 mg/100 g) in the consuming stage. They were significantly decreased in the consuming stage (Table 5). Medlar is considered to climacteric fruit. It has tree maturity stage and consuming stage. It is not edible during tree maturity stage due to its bitter taste. It is edible during the consuming stage (chocolate brown). Polyphenolics have high chemical activities; DNA, enzymes and proteins due to the properties of being linked to, is known for their defense against free radicals [13]. These results are in in agreement with Nadavi et al.,(2011) [14], reported that total phenolic compounds of medlar were 7.26-457.07 mg/100 g. Also, Rop et al.,(2011) [15] indicated that phenolic compounds were analyzed at five different maturity stages, such as 134 days, 144 days, 154 days, 164 days, 174 days after full blooming. And the results were determined as 170 mg/100 g, 169 mg/100 g, 145 mg/100 g, 117 mg/100 g, 93 mg/100 g. In addition to, Ercisli et al.,(2011) [12] reported that total phenolic compounds were found out 119-244 mg/100 g.

Table 5. Vitamin C, total phenolic compounds and total dry matter amount of medlar genotypes in maturity and consuming stage according to genotypes.

Genotypes	Vitamin C (mg/100 g)		Total Phenolic Compounds (mg/100 g)		Total Dry Matter (%)
	Maturity stage	Consuming stage	Maturity stage	Consuming stage	Maturity stage
60NA001	10.13	6.40	675.34±18.42	171.91±2.46	41.94
60NA003	23.00	9.60	426.08±12.99	387.61±20.78	34.09
60NH005	17.33	8.00	305.34±10.30	432.63±49.20	33.75
60EK004	23.33	26.67	431.81±3.54	194.01±12.09	42.28
60NT001	8.00	7.46	232.48±3.09	103.55±13.80	27.34
60PA058	10.67	8.50	313.93±3.75	305.75±13.67	36.21
60NH002	9.07	6.93	920.51±51.59	350.77±8.36	31.74
60EK014	21.50	7.46	697.86±35.95	453.09±23.33	44.11
60PM002	9.05	11.67	394.56±11.07	196.05±4.96	35.02
60TH001	11.06	8.00	572.20±18.17	114.60±5.80	29.16
60EK010	30.00	9.60	239.03±30.14	106.42±7.40	28.28

4. Conclusion and Recommendations

As a result, 11 genotypes, selected among many medlar genotypes in Tokat province, were planted to genetic resource plots. Those will be used in advance experiments and breeding studies.

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