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Research Article

Promising bay laurel (*Laurus nobilis* L.) genotypes for fruit production

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ABSTRACT

Bay laurel (*Laurus nobilis* L.) is an evergreen and dioecious tree or shrub plant with a small black fruit. This study was conducted to determine bay laurel genotypes with high-quality characteristics which grown intensively in Hatay. 149 female trees were preselected and then 49 laurel genotypes were used as material according to Turkish Standards (TS-5205) for fatty acid compositions. In the study, berry weights (0.77-1.76 g), kernel weights (0.49-1.12 g), kernel ratios (51.73-77.44%), dry matter ratios (44.89-69.44%), berry oil ratios (18.92-37.85%), berry flesh oil ratios (20.76-53.98%) and kernel oil ratios (11.75-27.49%) of genotypes were determined. The content of fatty acid compositions ranged between 12.74-31.19% for lauric acid, 12.35-19.91% for palmitic acid, 30.35-44.43% for oleic acid and 15.93-26.75% for linoleic acid. Genotype K9 has attracted attention with high lauric acid and low palmitic acid ratio. On the other hand, genotype ER6 for berry weight, B30 for kernel weight and ER14 for kernel oil ratio were found to be promising genotypes.

Keywords: Fatty acid compositions, Lauric acid, Selection, Hatay

Meyve üretimi için ümitvar defne (*Laurus nobilis* L.) genotipleri

ÖZ

Defne (*Laurus nobilis* L.), küçük siyah meyvesi olan herdem yeşil ve iki evcikli bir ağaç veya çalı formunda bir bitkidir. Bu çalışma, Hatay'da yoğun olarak yetişen yüksek kaliteli defne genotiplerini belirlemek için yürütülmüştür. Öncelikle 149 dişi ağaç önseçim yapılmıştır ve daha sonra yağ asitleri bileşimleri için Türk Standartlarına (TS-5205) göre 49 defne genotipi materyal olarak kullanılmıştır. Çalışmada, defne genotiplerinin meyve ağırlıkları (0.77-1.76 g), çekirdek ağırlıkları (0.49-1.12 g), çekirdek oranları (% 51.73-77.44), kuru madde oranları (% 44.89-69.44), meyve yağı oranları (% 18.92-37.85), meyve eti yağı oranları (% 20.76-53.98) ve çekirdek yağı oranları (% 11.75-27.49) belirlenmiştir. Yağ asidi bileşimlerinin içeriği, laurik asit için% 12.74-31.19, palmitik asit için% 12.35-19.91, oleik asit için% 30.35-44.43 ve linoleik asit için% 15.93-26.75 arasında değişmiştir. K9 genotipi yüksek laurik asit ve düşük palmitik asit oranıyla dikkat çekmiştir. Öte yandan, meyve ağırlığı için genotip ER6, çekirdek ağırlığı için B30 ve çekirdek yağı oranı için ER14'ün umut verici genotipler olduğu bulunmuştur.

Anahtar Kelimeler: Yağ asiti bileşimleri, Laurik asit, Seleksiyon, Hatay

1. INTRODUCTION

Bay laurel (*Laurus nobilis* L.) is an evergreen, dioecious plant in the form of a pyramidal-shaped tree or large bush of the Laurus genus of the Lauraceae family.[1,2] *Laurus nobilis* L., also known as Mediterranean bay laurel, is widely grown in Turkey, Greece, Italy, Spain, Portugal, France, Syria, Morocco, Algeria, Mediterranean Islands, and California[3-6]

Bay laurel is one of the most important medicinal plants of Turkey and grows naturally starting from the province of Hatay along the Mediterranean, Aegean, and the Black Sea coasts and up to 1200 m in the inner parts of these coastal areas.[7-9] In Turkey, 5500 tons of bay La-

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urel seeds are produced.[9-11] In addition, when the medicinal and aromatic plant exports values of recent years are examined, it is seen that bay laurel is one of the important plants as quantity and economic value. [11,12]

The olive-like berries of bay laurel are green in color firstly, when it matures, it becomes a bright bluish black color. Bay laurel berries reach physiological maturity in October-November and are collected at about 40% moisture.[13] In studies conducted with soxhlet extraction and supercritical CO_2 extraction of bay laurel berries, it was determined that bay berries contained 15-35.87% fixed oil.[14-18] However, the fixed oil content obtained by the traditional boiling method is about 10%. The berry flesh of bay laurel contains 26% and the kernel contains 18% fixed oils.[15,19] There are more than 20 fatty acids in the bay laurel oil.[20] The main components of bay laurel fixed oil are lauric acid, oleic acid, linoleic acid, and palmitic acid. Lauric acid is found only in the bay laurel berry kernel. The oil obtained from laurel berry is used in soap making, medicine, and cosmetics industry. In recent years, parallel to the demand for natural products the demand for bay laurel soap is increasing day by day, and bay laurel berries are used as a natural anthocyanin instead of synthetic dyes in the food, pharmaceutical, and cosmetic industries.[18]

There are no registered bay laurel species in Turkey yet. Laurel berries are collected from naturally grown trees. Naturally grown trees have a wide variation in berry yield, berry characteristics, fixed oil content, and components of berries.[18,21] For this reason, problems may occur from time to time in compliance with the standardization of oils. This study was carried out to develop new varieties in accordance with standards for oil components with high berry and oil yield and superior berry characteristics.

2. MATERIALS AND METHODS

In the experiment, bay laurel trees in the flora of Hatay with different characteristics were selected, and the coordinates and altitudes of them were registered. Berry oils of pre-selected genotypes were extracted and oil content and fatty acids composition were determined. The obtained data were evaluated according to TSE standards and 48 genotypes were determined to be in compliance with standards for fatty acids composition. Berries of 48 genotypes were examined for their pomological and chemical properties. In the experiment, berry samples were collected when they completely blackened period. Some of the characteristics examined in barires of 48 female genotypes are berry weight (g), ovality coefficient, kernel weight (g), kernel ratio (%), dry matter ratio (%), berry oil ratio (%), berry flesh oil ratio (%) and kernel oil ratio (%). Pomological features were determined in 50 bay barries. Oil extraction: Soxlet extracts were obtained in 100 g dried and grounded samples from each genotype. Oil samples were kept at 4°C until chemical analysis, which was duplicated.

Fatty acids composition: The components of the oils obtained from the berries of each genotype were analyzed by Hewlett Packard 6890 N model GC/MS. After esterification of the oils, the composition of fatty acids was determined on GC/MS. For this purpose, firstly 0.5 g of the oil sample is taken and methanolic NaOH was added and boiled under reflux for 10 minutes. With the disappearance of the oil droplets, 10 ml of B3 methanol complex was added, boiled for 10 minutes and then added with hexane.[22] Upper phase was taken into 2 ml vial bottle and read in GC/MS. Capillary column, HP-Innowax 60 meters diameter 0.25 micrometer, helium was used as carrier gas.

3. RESULTS AND DISCUSSION

In preselection studies 48 genotypes were selected according to fatty acid compositions. The altitude of the areas where 48 genotypes were collected ranged from 42 m to 985 m. The results of the researches carried out on the berries are given below.

3.1. Fixed oil contents

The dry matter and fixed oil ratios of the berries of bay laurel genotypes varied considerably compared to the genotypes. The values of the dry matter and fixed oil ratios of 48 genotypes berries are given in Table 1. The lowest value for the dry matter content of the berries was taken from the genotype O10 with 44.89% and the highest value was taken from the genotype B13 with 69.44%. The average dry matter content of the berries gathered from the pre-selected genotypes was 61.80%. The lowest value for whole berries (together with the kernel and berry flesh) oil content was obtained from the genotype SK3 with 18.92% while the highest value was obtained from genotype ER16 with 37.85%. The average of fixed oil percentage of the berries of examined genotypes was 27.73%. As in other features, there is a considerable variation in the fixed oil ratios among genotypes (Table 1). When we examined the previous studies; in studies conducted in Turkey, Yazıcı[23] reported that the fatty oil ratio of bay laurel berry was between 13.05% and 18.11%; found that the ratio of fatty oil of bay laurel berry varied between 17.52% and 28.14% in their study in Lebanon. Marzouki and co-workers[16] reported that the ratio of fatty oil of bay laurel berry was between 17.1% and 27.6% in Tunisia. Beis and Dunford[15] found between 14-28% in their study. The result that we obtained showed similarities with

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Table 1. Dry matter ratio and fixed oil contents of bay laurel genotypes (%)

Genotypes	Dry Matter Ratio	Berry Oil Ratio	Berry Flesh Oil Ratio	Kernel Oil Ratio	Genotypes	Dry Matter Ratio	Berry Oil Ratio	Berry Flesh Oil Ratio	Kernel Oil Ratio
YY5	64.28	24.30	20.76	11.75	**ER17**	59.47	37.05	41.92	26.49
YY8	61.04	25.90	35.53	16.26	**ER21**	62.98	30.68	37.15	20.92
ŞK3	65.21	18.92	21.91	18.92	**ER27**	65.85	33.47	44.53	22.91
ŞK5	62.48	26.49	36.32	16.66	**ER41**	51.95	32.07	44.86	21.91
ŞK6	52.18	27.29	21.12	17.33	**ER44**	60.17	28.88	44.02	20.72
O4	65.73	24.70	33.93	15.46	**ER46**	57.78	26.10	43.91	22.31
O10	44.89	27.09	32.07	16.14	**ER47**	63.70	30.88	40.64	22.31
E5	65.76	32.87	35.66	25.10	**ER48**	63.33	24.30	38.61	22.31
E6	63.33	28.88	37.72	25.30	**B3**	58.42	27.49	41.09	18.92
E8	63.93	22.31	47.01	17.33	**B5**	63.00	24.90	44.02	16.73
E9	60.60	31.67	48.02	25.70	**B13**	69.44	28.06	41.09	19.07
HB4	64.25	24.50	33.66	15.33	**B21**	54.48	21.51	48.90	12.55
K2	65.02	23.90	44.62	15.94	**B30**	57.79	26.10	43.82	18.92
K5	62.60	29.68	36.36	16.93	**B33**	61.79	26.69	39.84	16.14
K8	62.14	23.90	28.49	17.13	**B34**	69.25	25.10	34.46	15.73
K9	64.41	22.31	33.86	16.33	**D2**	64.19	33.07	49.30	23.71
K10	61.45	26.69	39.04	19.72	**D4**	64.91	30.68	52.67	20.72
K12	60.25	24.50	48.61	18.13	**D13**	65.54	30.28	44.91	21.31
K15	64.44	22.71	42.97	16.53	**H2**	56.10	33.27	40.36	19.92
BA7	64.22	24.50	33.53	16.14	**H10**	65.54	33.07	34.92	13.73
ER6	57.31	34.06	39.64	21.71	**SY2**	58.93	25.70	42.97	13.75
ER10	61.53	27.09	45.80	22.31	**SY3**	60.09	25.70	38.25	18.13
ER14	63.09	34.26	47.01	27.49	**S6**	66.45	21.71	31.27	17.53
ER16	67.73	37.85	53.98	22.51	**S8**	66.79	26.49	42.23	14.34

Dry Matter: Min: 44.89; Max: 69.44; Mean: 61.80; STD: 4.63; CV: 7.49, Berry Oil Ratio: Min: 18.92; Max: 37.85; Mean: 27.73; STD: 4.28; CV: 15.43, Berry Flesh Oil Ratio: Min: 20.76; Max: 53.98; Mean: 39.56; STD: 7.42; CV: 18.76, Kernel Oil Ratio: Min: 11.75; Max: 27.49; Mean: 19.05; STD: 3,76; CV: 19.74.

these values in some point of view and all of these results indicate that the fatty oil content of the bay laurel berry has changed according to genotypes, growing region, climatic differences the time of collection and the morphological and physiological structure of the collected plant.

In the analysis to determine the fixed oil ratios contained only in the berry flesh of bay laurel berry, the lowest value for the ratio of flesh fixed oils was determined in genotype YY5 with 20.76% and the highest value of 53.98% in genotype ER16. The average berry flesh fixed oil ratio of the genotypes was 39.56% (Table 1). The lowest value obtained in the analysis of fixed oils in the kernels of bay laurel berries was taken from the genotype YY5 with 11.75% and the highest value with 27.49% from the genotype ER14. The average fixed oil content of the berry kernels of pre-selected bay laurel genotypes grown in Hatay region was determined as 19.05% (Table 1). Genotypes with high kernel fixed oil should be taken into consideration when evaluating future work. Because lauric acid is found in the kernel rather than berry flesh.

3.2. Fatty acids compositions

In the analysis of the fixed oils obtained from the berries of each genotype, the fatty acids compositions were determined and given in Table 2. The genotype with the highest lauric acid ratio in the study was K9 with 31.19% and the genotype with the lowest value was H10 with 12.74%. The genotype K9 has also attracted attention with a low palmitic acid ratio (12.35%). The genotype

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the highest rate of palmitic acid was B21 with 19.91%. The average oleic acid content of the genotypes was determined to be 37.08% and the highest value was determined in the genotype H2 with 44.43% and the lowest value was found in the genotype O10 with 30.35%. The mean of the linoleic acid content of the genotypes was 23.09%, and the K2 genotype was the lowest with 15.93% and the SY3 genotype was the highest with the linoleic acid ratio of 26.75%. As can be understood from Table 2, the most common fatty acid in bay laurel berry is oleic acid. However, the characteristic of bay laurel fixed oil is that it is originated from lauric acid. Lauric acid is only present in the kernel of the berry and according to Turkish Standardization (TS-5205), bay laurel oil cannot be exported if lauric acid is less than 12.5%. For this reason, the amount of lauric acid is the foreground for bay laurel oil. As a matter of fact, genotypes containing about 30% of lauric acid were determined in the study. Especially, K2 and K9 have become genotypes that attract attention in this respect. As regards to fixed oil composition, the results showed similar variations with[15] that studied in flora of Turkey. These results were also within the range of fatty acids composition previously reported in literature.[16, 24,25]

Table 2. Fatty acids compositions of bay laurel genotypes (%)

Genotypes	Lauric Acid	Palmitic Acid	Oleic Acid	Linoleic Acid	Genotypes	Lauric Acid	Palmitic Acid	Oleic Acid	Linoleic Acid
YY5	15.83	18.73	41.40	24.04	**ER17**	18.09	17.63	37.71	22.87
YY8	17.57	19.58	35.28	25.03	**ER21**	12.75	19.60	38.32	25.99
ŞK3	19.35	17.79	33.44	26.64	**ER27**	18.09	17.92	34.59	25.09
ŞK5	25.20	14.55	36.51	19.49	**ER41**	22.22	17.28	37.08	23.43
ŞK6	20.74	17.00	37.98	20.30	**ER44**	15.87	17.58	39.26	23.18
O4	16.20	17.33	39.89	23.26	**ER46**	15.24	17.89	38.80	24.68
O10	22.01	19.61	30.35	24.08	**ER47**	21.69	18.48	36.73	19.60
E5	25.03	14.78	31.62	24.99	**ER48**	18.66	16.26	38.71	22.88
E6	19.41	16.10	35.49	26.29	**B3**	18.88	18.86	37.86	20.71
E8	16.59	17.59	37.98	24.72	**B5**	12.79	18.98	38.86	26.33
E9	18.39	16.47	37.92	23.88	**B13**	17.55	19.03	38.45	23.16
HB4	21.79	16.32	34.49	23.38	**B21**	20.08	19.91	33.14	23.68
K2	31.17	14.93	37.97	15.93	**B30**	18.98	17.83	39.94	21.69
K5	25.55	14.27	36.80	19.65	**B33**	13.65	18.46	39.01	24.41
K8	24.24	16.48	35.58	21.35	**B34**	26.70	16.48	33.71	23.10
K9	31.19	12.35	34.22	19.20	**D2**	19.87	18.29	33.17	25.23
K10	22.02	15.05	40.21	22.71	**D4**	18.90	18.83	36.54	23.73
K12	17.55	19.70	34.79	24.83	**D13**	21.51	19.63	32.67	23.99
K15	23.77	14.87	32.79	24.50	**H2**	14.67	15.95	44.43	21.89
BA7	15.98	16.22	41.35	21.97	**H10**	12.74	19.28	40.08	23.84
ER6	16.57	18.57	38.08	23.90	**SY2**	16.20	17.35	37.62	25.54
ER10	20.29	15.08	40.22	21.63	**SY3**	15.00	14.60	39.80	26.75
ER14	15.32	14.49	36.77	18.42	**S6**	23.35	15.81	34.85	19.70
ER16	17.50	16.98	39.81	22.53	**S8**	16.28	18.39	37.74	24.26

Lauric acid: Min: 12.74; Max: 31.19; Mean: 19.35; STD: 4.27; CV: 22.07, Palmitic acid: Min: 12.35; Max: 19.91; Mean: 17.19; STD: 1.80; CV: 10.47, Oleic acid: Min: 30.35; Max: 44.43; Mean: 37.08; STD: 2.86; CV: 7.71, Linoleic acid: Min: 15.93; Max: 26.75; Mean: 23.09; STD: 2.34; CV: 10.13.

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3.4. Pomological characteristics

The weights in bay laurel berry revealed quite large variations among genotypes (Coefficient of Variation 19.08). The values of the berry weights of 48 female genotypes are given in Table 3.

The lowest berry weights of the genotypes were taken from D13 with 0.77 g and the highest value from ER6 with 1.76 g. The average weight of the berries was found to be 1.31 g. The distribution of berry weight generally appears to be concentrated between 1.00 g and 1.50 g. The average fruit weight was higher than that of the values obtained by Karik and co-workers (1.06 g) [18], Baytöre (0.93 g)[17] and Boza (1.04 g).[26] This is an expected result as the genotypes selected for pre-selection studies.

In order to obtain information about the berry shape of the bay laurel plants growing in the region, round or long shape, ovality coefficients were determined by calculating the ratio of the berry length and berry width of berries. Genotypes with 1 ovality coefficient are round form berry types. The genotype with the highest ovality coefficient of the berry was genotype D13 with 0.89, while the lowest ovality coefficient was obtained from

Table 3. Pomological characteristics of bay laurel genotypes

Genotypes	Berry weight	Ovality Coef.	Kernel Weight	KernelRatio	Genotypes	Berry weight	Ovality Coef.	Kernel Weight	KernelRatio
YY5	1.41	0.76	1.02	72.48	ER17	1.24	0.76	0.71	57.58
YY8	1.45	0.77	0.91	62.74	ER21	1.53	0.72	1.03	67.32
ŞK3	1.27	0.61	0.90	70.98	ER27	1.21	0.81	0.78	64.30
ŞK5	1.18	0.75	0.74	62.75	ER41	1.62	0.61	0.99	60.99
ŞK6	1.01	0.63	0.66	65.82	ER44	1.46	0.72	0.86	58.77
O4	1.12	0.71	0.70	62.75	ER46	1.44	0.83	0.89	61.94
O10	1.17	0.73	0.73	61.98	ER47	1.25	0.67	0.82	65.92
E5	0.97	0.78	0.65	66.80	ER48	1.12	0.74	0.67	60.00
E6	1.00	0.74	0.68	68.20	B3	1.10	0.78	0.65	59.45
E8	1.58	0.78	1.04	65.95	B5	1.40	0.75	1.06	75.73
E9	1.54	0.80	0.98	63.38	B13	0.83	0.73	0.49	59.13
HB4	1.17	0.70	0.73	62.75	B21	1.33	0.73	0.78	58.86
K2	1.35	0.60	1.05	77.44	B30	1.67	0.68	1.12	67.26
K5	0.98	0.67	0.53	54.23	B33	1.08	0.82	0.78	72.17
K8	1.58	0.62	0.97	61.34	B34	1.61	0.72	1.01	62.71
K9	1.33	0.87	0.94	71.04	D2	0.99	0.83	0.62	63.03
K10	1.45	0.82	0.80	55.30	D4	1.29	0.80	0.79	60.93
K12	1.50	0.72	0.78	51.73	D13	0.77	0.89	0.51	66.75
K15	1.10	0.86	0.70	63.43	H2	1.65	0.74	1.02	61.94
BA7	1.31	0.84	0.94	72.00	H10	1.21	0.67	0.75	61.98
ER6	1.76	0.61	0.93	52.90	SY2	1.52	0.62	0.85	55.59
ER10	1.32	0.70	0.89	67.58	SY3	1.74	0.75	0.98	56.07
ER14	1.06	0.76	0.68	64.34	S6	1.67	0.58	1.02	61.15
ER16	1.07	0.74	0.65	60.37	S8	1.47	0.62	0.88	59.55

Berry weight: Min: 0.77; Max: 1.76; Mean: 1.31; STD: 0.25; CV: 19.08, Ovality Coefficient: Min: 0.58; Max: 0.89; Mean: 0.73; STD: 0.08; CV: 10.96
Kernel Weight: Min: 0.49; Max: 1.12; Mean: 0.82; STD: 0.16; CV: 19.51, Kernel Ratio: Min: 51.73; Max: 77.44; Mean: 63.33; STD: 5.65; CV: 8.92

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the genotype ER14 with 0.58. According to these results, the most rounded genotype is D13 and the longest genotype is genotype ER14. Average ovality coefficient of laurel trees grown in the region was determined as 0.73.

It has been determined that there are also quite large variations among kernel weights of bay laurel genotypes. The values for the kernel weights of the 48 female bay laurel genotypes are given in Table 3. The lowest value for the kernel weights was taken from B13 with 0.49 g and the highest value with 1.12 g from genotype B30. The average kernel weight of the berries was found to be 0.82 g.

In the study, the lowest value for kernel ratios of genotypes was obtained from the genotype K12 with 51.73% and the highest value from genotype K2 with 77.44%. The average kernel ratios of the berries were determined as 63.33%.

The kernel ratios and kernel weight of the berry appear as an important criterion in bay laurel selection. Because, lauric acid is only present in the kernel of bay laurel berries. For this reason, in order to obtain genotypes with the high lauric acid ratio, genotypes with higher kernel ratio and kernel oil contents should be given priority in selection.

4. CONCLUSIONS

The result that we obtained indicates that the fatty oil content of the bay laurel berry has changed according to genotypes, growing region, climatic differences the time of collection and the morphological and physiological structure of the collected plant. It can be concluded that there is a great variation among the genotypes in the flora. In the study, the K9 genotype has attracted attention with a high lauric acid and low palmitic acid ratio. On the other hand genotype ER6 for berry weight, B30 for kernel weight and ER14 for kernel oil ratio were found to be promising genotypes. Studies should be continuing on this genotype.

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Conflict of interest

We declare that there is no a conflict of interest with any person, institute, company, etc.

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