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Oral Presentation

Comparison of total lipid contents and fatty acid components of some pecan varieties

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Pecan (*Carya illinoensis*) is a nut species of subtropical climates belonging to the family of Juglandaceae. Among the most important features that differentiate the lipid content and higher kernel content than other nut species especially walnuts. The shell in pecan nuts can be broken easily by hand, kernels can be stored for longer periods. Pecans can be grown in subtropical climates where walnuts have limited potential. Pecan has the potential to grow in Turkey, particularly in the Mediterranean and Southeastern Anatolia regions followed by Aegean region. Pecan has suitable ecological conditions for growing in Çanakkale. In this study which was carried out in 2012, the total lipid content and the fatty acid components of some important pecan varieties were investigated by Soxhlet extraction method and chromatography techniques. During the study Western, Wichita, Mohawk, Pawnee, Desirable. Burkett, Mahan X Stuart, Cheyenne, Big Z, and Moneymaker pecan varieties were used and compared. While the Western variety was the first with 75,48% in terms of total lipid content, the lowest rate was determined in Moneymaker with 67,66%. Pecan oils surveyed for fatty acids by gas chromatography. Palmitic acid (C16:0), stearic acid, oleic acid (C18:1), linoleic acid (C18:2) and linolenic acid (C18:3) chromatograms were obtained. The highest fatty acid component ratio was 79,42 in oleic acid and the lowest fatty acid component ratio was 0.13 and linolenic acid in Pawnee. Studies should be enlarged in Çanakkale ecological conditions to promote the cultivation of pecan nut varieties and to introduce them to producers.

Keywords: Juglandaceae, kernel quality, chromatography

INTRODUCTION

The homeland is the Mississippi – Missouri basin in North America. Pecan grows temperate climates more than standard walnuts. America is also defined as the golden tree of poor lands. Internal yield is better than standard walnut. It has the highest crown volume compared to other garden plants. It is a plant that can be cultivated in all other soils except saline soils (Tuzcu & Kaplankıran, 1993).

Pecan (*Carya illinoensis* Koch.) is a nut species of subtropical climates belonging to the family of *Juglandaceae*. Among the most important features that differentiate the lipid content and higher kernel content than other nut species especially walnuts (Pyriadi & Mason, 1968; Pinheiro do Prado et al., 2009). The shell in pecan nuts can be broken easily by hand, kernels can be stored for longer periods. Pecans can be grown in subtropical climates where walnuts have limited potential. Pecan has the potential to grow in Turkey, particularly in the Mediterranean and Southeastern Anatolia regions followed by Aegean region. Pecan has suitable ecological conditions for growing in Çanakkale.

Tree nuts are cholesterol-free and full of nutrients, including fat, protein and fiber. Nuts are also a great source of vitamins such as folic acid, niacin and vitamin E and B6, and minerals like magnesium, copper, zinc, selenium, phosphorus and potassium. Some nuts are good sources of antioxidants such as vitamin E, selenium, and certain phytochemicals (Rajaram et al., 2001).

Considerable amounts of pecan nuts are grown in the USA and Mexico. 93% of world total pecan nut production is provided by the USA and Mexico. According to the USDA statistical database in 2017, 250.000 tons of pecans were produced in the USA in Georgia, New Mexico, Texas, Arizona and Alabama (FAO, 2018).

The pecan nut has low saturated fatty acid content and high levels of monounsaturated and polyunsaturated fatty acids. Evidence also indicates the presence of bioactive molecules, such as sterols and tocopherols, and a high content of total phenolic compounds, with possible natural antioxidant activity (Kris-Etherton et al., 1999; Pinheiro do Prado et al., 2009). Pecans are 65 to 75% lipid, depending on growing conditions, maturity, cultivar, geographic location, and past productivity of the tree (Pyriadi & Mason 1968; Woodroof 1979; Santerre 1994). Pecan lipids are 9% unsaturated and contain approximately 65% monounsaturated fatty acids (MUFA) (Senter & Horvat 1976). Therefore, pecan lipids meet the criteria for high MUFA content as part of a cholesterol-lowering diet. The first studies in our country related to pecan nuts; It was launched in 1953 as a seed in the USA and in 1969 in the Antalya Citrus Research Institute with 14 culture types brought from Israel via FAO.

MATERIALS AND METHODS

A total of 10 varieties (Western, Wichita, Mohawk, Pawnee, Desirable, Burkett, Mahan X Stuart, Cheyenne, Big Z, and Moneymaker) were studied during the experiment during 2012 harvesting seasons. The trees were planted in the Experimental Plot of the Department of Horticulture, Faculty of Agriculture, University of Çukurova in Adana-Turkey. Fruit samples were manually harvested from three trees of each variety. All the trees were more than 20 years old and cultivated under optimum management techniques. A total of 100 fruit samples from each tree of the varieties were collected from the beginning of November 2012. Trees of the same variety were harvested on the same day. The nut images of 'Burkett', 'Mohawk', 'Moneymaker' and 'Pawnee' pecan varieties were shown in Figure 1., Figure 2., Figure 3. and Figure 4.

Pecan oil was extracted by hydraulic press and centrifugation processes. The samples were pressed two times, and the oil was centrifuged at 3000 × g for 15 min. The supernatant was stored in amber bottles under nitrogen at −24 °C until required for further analyses.



Figure 1. Nut appearance of 'Burkett' pecan variety

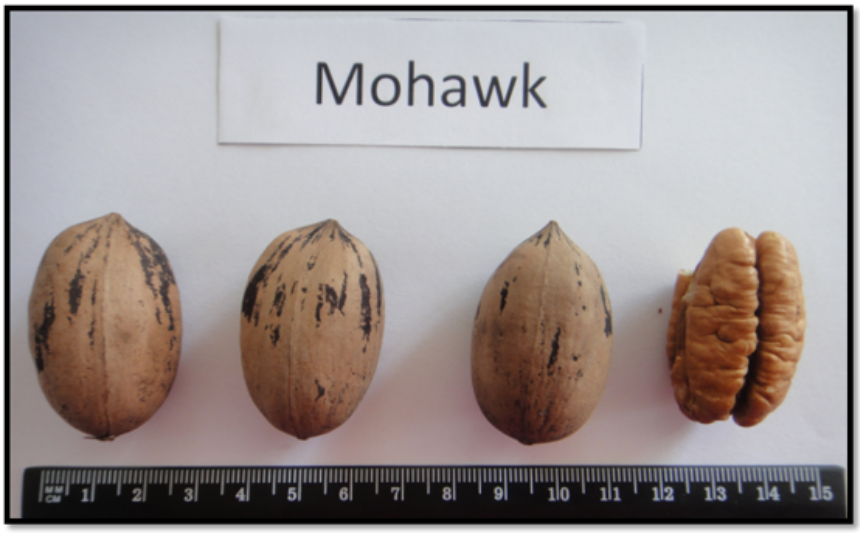


Figure 2. Nut appearance of 'Mohawk' pecan variety



Figure 3. Nut appearance of 'Moneymaker' pecan variety

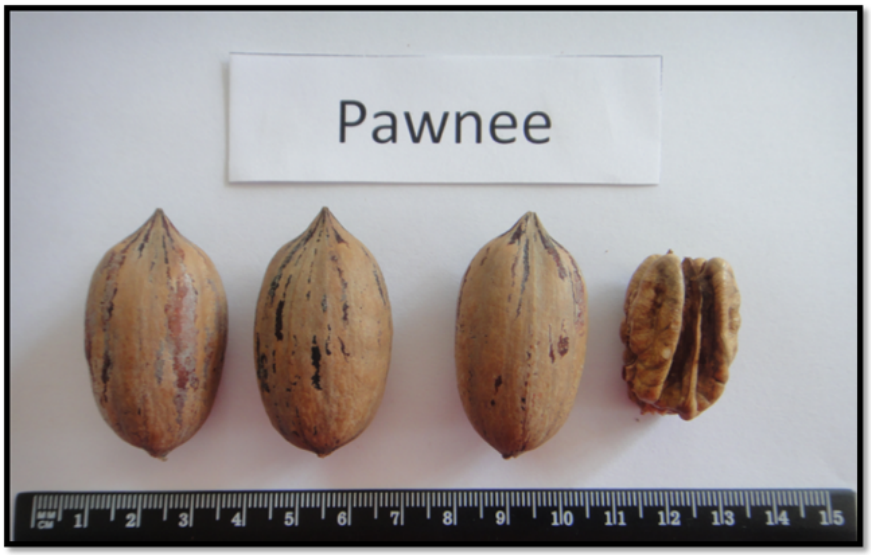


Figure 4. Nut appearance of 'Pawnee' pecan variety

For analysis, approximately 1000 g of nuts per variety were mechanically cracked and the kernel which included the brown outer testa or pellicle was separated from the shell, which is the hard cover that surrounds the kernel. After removal of rotten and necrotic kernels, healthy pecan halves were stored at -80 ◦C in freeze-resistant plastic bags.

Fatty acid methyl esters (FAME) were prepared from extracted oil by the method of Slover & Lanza (1979). Briefly, approximately 200 mg extracted oil was treated with 1 ml methanolic NaOH at 100 ◦C for 15 min in round, glass-stoppered tubes. The tubes were cooled on ice, 2 ml boron trifluoride was added and the tubes were boiled for a further 15 min. The tubes were cooled on ice, then 1 ml iso-octane and 2 ml saturated sodium chloride were added, shaken vigorously and left to stand to allow the layers to separate. The upper hexane layer containing the FAME was transferred to a small tube and stored at /20 ◦C for later analysis by gas chromatography - mass spectrometry (GC-MS). For FAME analysis, a DB-WAX capillary column (30 m/0.32 mm i.d.; J & W Scientific, Folsom, California, USA) was used. The column was connected to a Shimadzu QP2010 Plus (Kyoto, Japan) gas chromatograph equipped with a flame ionization detector. Helium was used as the carrier gas. The temperature program was as follows: initial temperature, 50◦C; increase to 200◦C at 10◦C/min, hold for 25 min; and increase to 230◦C at 10 ◦C/min, hold for 20 min. Injector and detector temperatures were 250 ◦C.

RESULTS

Comparison of Total Lipid Contents

Pecan oil content results were presented in Table 1. and Figure 5. Lipid extraction and measurements showed that the total lipid contents of the pecan varieties ranged from 67.66% for the 'Moneymaker' to 75.48% for the 'Western'. All pecan varieties had high pecan oil content.

Table 1. Comparison of the total fat content and fatty acid components of some pican varieties (%)

Variety	Total Lipid Content (%)	Palmitic Acid (C16:0)	Stearic Acid (C18:0)	Oleic Acid (C18:1)	Linoleic Acid (C18:2)	Linolenic Acid (C18:3)
Big Z	69.12	6.73	2.49	62.04	27.93	0.86
Burkett	71.71	5.76	2.32	70.96	20.34	0.67
Cheyenne	69.4	6.44	2.16	58.85	31.68	0.92
Desirable	72.97	7.41	2.5	64.61	24.57	0.96
Mahan X Stuart	71.19	5.8	2.52	69.93	21.11	0.69
Mohawk	73.71	5.95	2.13	73.55	17.69	0.73
Moneymaker	67.66	8.94	3.01	50.78	35.73	1.59
Pawnee	73.21	5.76	1.91	79.42	12.83	0.13
Western	75.48	5.86	2.31	79.2	12.1	0.58
Wichita	74.62	7.16	2	67.46	22.53	0.9

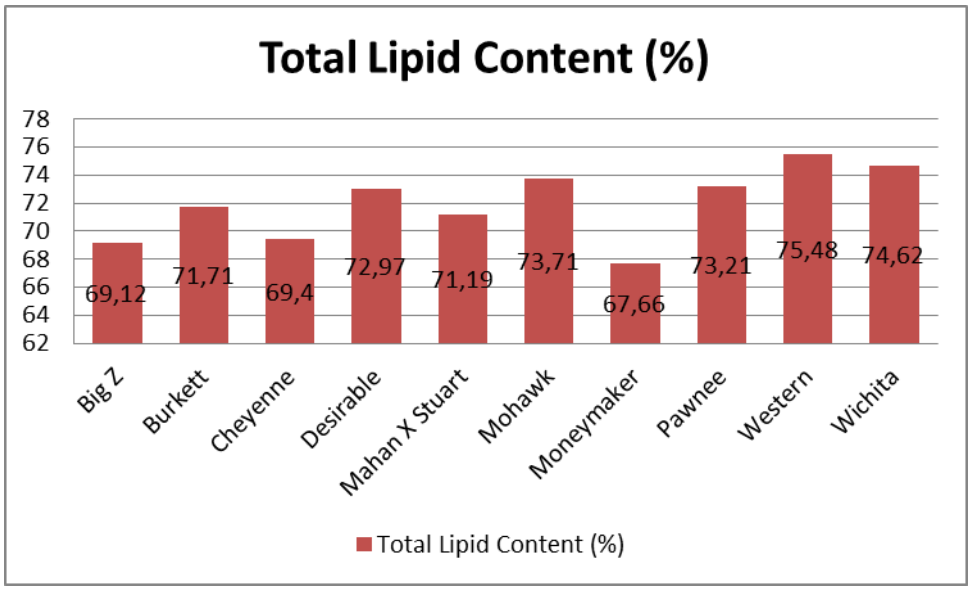
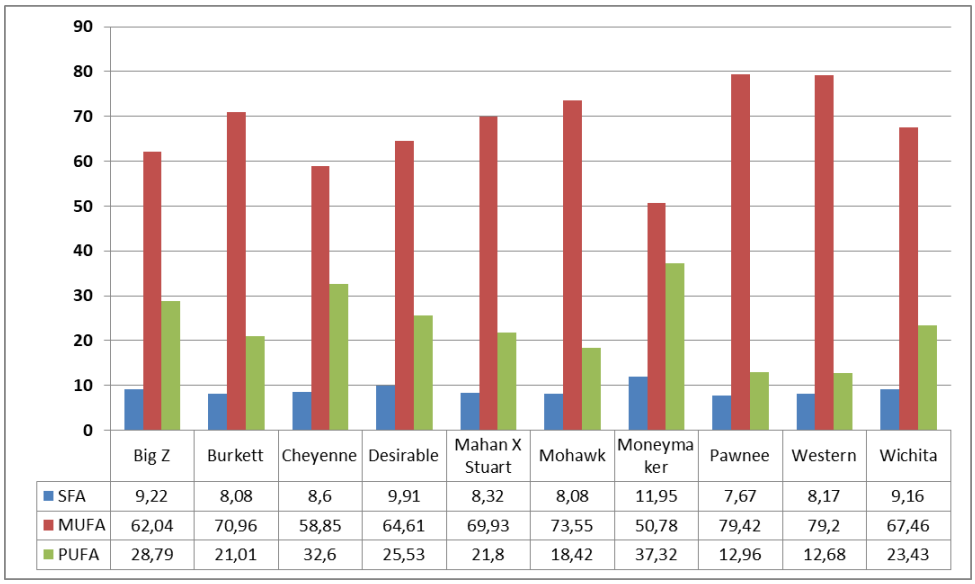


Figure 5. Comparison of lipid contents of pecan varieties



	Big Z	Burkett	Cheyenne	Desirable	Mahan X Stuart	Mohawk	Moneymaker	Pawnee	Western	Wichita
SFA	9,22	8,08	8,6	9,91	8,32	8,08	11,95	7,67	8,17	9,16
MUFA	62,04	70,96	58,85	64,61	69,93	73,55	50,78	79,42	79,2	67,46
PUFA	28,79	21,01	32,6	25,53	21,8	18,42	37,32	12,96	12,68	23,43

Figure 6. Comparison of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsatyrated fatty acids (PUFA) of pecan varieties

Comparison of Fatty Acid Components

Fatty acid contents of investigated pecan varieties were presented in Table 1. Chromatography analysis showed that palmitic acid (C16:0) contents of the pecan varieties ranged from 5.76% for 'Western' to 8.94% for 'Moneymaker'. According to obtained data, 'Moneymaker' showed the highest stearic acid (C18:0) content (3.01%), followed by 'Mahan X Stuart' (2.52%). 'Pawnee' showed the highest oleic acid (C18:1) content (79.42%), followed by 'Western' (79.20%). As far as linoleic acid (C18:2) content is concerned, a wide variability was noticed. Some varieties had high contents, such as those obtained from varieties like 'Moneymaker' (35.73%) and 'Cheyenne' (31.68%); on the other hand, 'Pawnee' and 'Western'had the lowest linoleic acid content (12.83% and 12.10% respectively). The average linolenic acid (C18:3) of the pecan varieties ranged from 0.13% for 'Pawnee' to 1.59% for 'Cheyenne'. Comparison of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsatyrated fatty acids (PUFA) of pecan varieties were presented in Figure 6.

DISCUSSION

The obtained datas showed that pecan varieties had high lipid contents. Our findings have accordance with the results of Toker et al. (2015). Pecan oils have lower SFA and higher MUFA and PUFA contents as previously reported by Kris-Etherton et al., 1999; Moodley et al. 2007; Bouali et al. 2013.

CONCLUSIONS

While the Western variety was the first with 75.48% in terms of total lipid content, the lowest rate was determined in Moneymaker with 67.66%. Pecan oils surveyed for fatty acids by gas chromatography. Palmitic acid (C16:0), stearic acid, oleic acid (C18:1), linoleic acid (C18:2) and linolenic acid (C18:3) chromatograms were obtained. The highest fatty acid component ratio was 79.42% in oleic acid and the lowest fatty acid component ratio was 0.13% and linolenic acid in 'Pawnee' (Table 1.).

Studies should be enlarged also in Çanakkale ecological conditions to promote the cultivation of pecan nut varieties and to introduce them to producers.

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