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Testing of waste vegetable oils as color modifiers in American walnut (*Juglans nigra* L.) wood

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Abstract

American walnut (*Juglans nigra* L.) wood is used for veneer due to its beautifully grained and dark-colored wood. This study was conducted to test the use of plant waste oils as color modifiers on American walnut wood. As waste vegetable oils, discarded walnut, olive, corn, and sunflower oils were employed. After applying waste oils to the wooden surfaces, several surface properties (brightness, color, and whiteness index: *WI**) were determined. It was observed that multivariate analysis of variance tests conducted for *WI** values and color parameters were found to be statistically significant. For all vegetable waste oils, decreases were identified in *L**, *C**, h^o, and *b** parameters, as well as in *WI** values and glossiness values (for all degrees and orientations). The Δ*E** values were measured at 19.18 for sunflower, 22.02 for walnut, 22.65 for corn, and 19.49 for olive. Each of the discarded vegetable oils had an impact on the color of the wooden surface.

Keywords: Colour, *Juglans nigra* L., American walnut, whiteness index, waste vegetable oil

Amerikan ceviz (*Juglans nigra* L.) odununda renk değiştirici olarak bitkisel atık yağların denenmesi

Öz

Amerikan ceviz (*Juglans nigra* L.) ahşabı, güzel damarlı ve koyu renkte ahşabı sayesinde kaplama olarak kullanılmaktadır. Bu çalışma, Amerikan ceviz odununda renk değiştirici olarak bitkisel atık yağların denenmesi üzerine yapılmıştır. Atık bitkisel yağlar olarak, hizmet ömrünü tamamlamış olan ceviz, zeytin, mısır ve ayçiçeği yağları kullanılmıştır. Atık yağların ahşap malzeme yüzeylerine uygulanması sonrasında çeşitli yüzey özellikleri (parlaklık, renk ve beyazlık indeksi: *WI**) belirlenmiştir. Araştırma bulguları incelendiğinde, *WI** değerlerine ve renk parametrelerine ait testler için yapılan çok değişkenli varyans analizlerinin anlamlı olarak tespit edildiği görülmüştür. Bütün bitkisel atık yağlar tarafından *L**, *C**, h^o ve *b** parametreleri, *WI** değerleri ve parlaklık değerlerinde (bütün derece ve yönler için) azalmalar belirlenmiştir. Δ*E** değerleri ise ayçiçeğinde 19.18, cevizde 22.02, mısırda 22.65 ve zeytinde 19.49 olarak elde edilmiştir. Bütün bitkisel atık yağlar ahşap malzeme yüzeyine ait rengi değiştirici etkide bulunmuştur.

Anahtar kelimeler: Renk, *Juglans nigra* L., Amerikan ceviz, beyazlık indeksi, atık bitkisel yağ

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1 Introduction

Wood can be attacked by several types of pathogenic organisms, such as white, brown, and soft rot, or mold and stain fungi leading to the degradation of structural polymers of wood (Goodell et al., 2020). The most common materials used to create protective and decorative coatings for wood structures are coating materials based on drying oils and alkyd resins. However, oil-based materials have many advantages for woodworking and construction structures. These include protection against blue mold and other fungi. They also protect wood structures from insects, bark beetles, and other pests. Furthermore, they offer UV protection. They also have high adhesion strength. Additionally, they resist changes caused by weather conditions, temperature, and condensation (Yaremchuk et al., 2011).

All vegetable oils contain mixed unsaturated fatty acid chains and mixed triglycerides as their main components. Vegetable oils also typically include non-glyceride components that are often undesirable for edible and chemical products. These non-glyceride components include phospholipids, sterols, tocopherols, fatty alcohols, hydrocarbons, and coloring materials (Ikeiensikimama, 1991; Udoye and Nwabuonu, 2021).

Black walnut (Juglans nigra L.) is one of the rarest and most coveted native hardwoods. Also known as eastern walnut and American walnut.. Small natural groves that are often found in moist alluvial soils have been extensively harvested (Williams, 1990). Immature fruits can be pickled (Facciola, 1990). The seeds are found singly or in pairs and are approximately 3-4 cm in diameter (Elias, 1980; Sargent, 1965). Boiling the green fruit husks can yield a yellow dye. The woody husks of the fruits have been used in jewelry making (Duke, 1983). Brown dye can be obtained from the leaves and stems, and it does not require mordants (Grae, 1974). Depending on the latitude, black walnut flowers typically begin to appear in the South in mid-April and gradually extend into early June in the northern part of its range. Flowering and leaf drop occur at approximately the same time and always occur early enough for potential damage from late spring frosts (Lamb, 1915; Funk, 1979; Williams, 1990). The allelopathic effects of black walnut (*Juglans nigra* L.), a tree that has toxic effects on other plants, have been noted since the 1st century AD (Gries, 1943).

Black walnut is found in various areas, but it thrives in deep, well-drained, moist, and fertile neutral soils (Williams, 1990). Its wood is typically straight-grained, easily worked with hand tools, and possesses excellent machining properties. In surface treatments, the wood acquires a smooth velvety surface and a pleasing grain pattern (Anonymous, 1953; Rink, 1988). The wood of this tree, with its dark-colored, beautiful grain, is well-suited for fine cabinet work and interior paneling, both as solid wood and as veneer. It has long been the standard wood for gunstocks (Betts, 1954).

In *Juglans nigra* L. wood, the air-dried density is 796 kg/m^3. The Janka hardness values are 89.38 N/mm^2 in the tangential surface. They are 85.53 N/mm^2 in the radial surface, and 101.94 N/mm^2 in the transverse surface. The nail's holding resistance is 15.33 N/mm^2 on the tangential surface. On the radial surface, it's 18.65 N/mm^2 and on the transverse surface, it's 13.92 N/mm^2 (Ayata and Bal, 2019). Holocellulose is 76.40%, cellulose is 43.00%, and lignin is 21.80%. Ethanol solubility is 5.90%. Hemicellulose is 33.40%, pentosans are 17.40%, and hexosans are 16.00% (Waliszewska et al., 2015).

In this study, some waste oils (walnut, sunflower, corn, and olive) were tested as color modifiers in American walnut (*Juglans nigra* L.) wood. According to the literature, it has been observed that there hasn't been any application of waste vegetable oil related to this tree species. This study has been considered to address this gap. The aim is to provide valuable information regarding the potential uses of this wood type based on the obtained results.

2 Material and Method

2.1 Material

2.1.1 Wood material

This research used American walnut (*Juglans nigra* L.) wood in experimets The experimental wood material was obtained from a commercial source, meeting the first-grade quality criteria, and had dimensions of 100 mm x 100 mm x 20 mm. Particular attention was given to selecting samples that were devoid of cracks, had uniform and smooth fibers, and were free from knots, resin pockets, and noticeable color or density discrepancies. Following this, the specimens were prepared in accordance with the TS ISO 13061-1 (2021) standard.

2.1.2 Waste vegetable oils

Walnut, sunflower, corn, and olive oils, which have reached the end of their service life as waste products after use in various restaurants, were used in this study. The packaging specifications of these waste oils in their pre-utilization state are presented in Table 1.

Table 1. Some properties of the waste bio-oils used

Feature (per 100 g)	Olive	Corn	Walnut	Sunflower
Saturated fatty acid	15.15	12.00	9.10	10.00
Monounsaturated fatty acid	74.00	28.00	-	33.00
Polyunsaturated fatty acid	10.50	51.00	-	57.00

2.2 Method

2.2.1 Application of vegetable waste oils to wooden material surfaces

Wood material surfaces were sanded with 80, 100, and 150 grit sandpapers. Subsequently, the sanded surfaces were cleaned using a compressor. Waste oils were then applied to the prepared materials using a brush in a single layer. The samples were allowed to dry for at least 3 weeks..

2.2.2 Determination of whiteness index (*WI**) properties

Whiteness index (*WI**) values were assessed in both perpendicular and parallel directions to the fibers utilizing the Whiteness Meter BDY-1 instrument, adhering to the ASTM E313-15e1 (2015) standard.

2.2.3 Determination of glossiness properties

Glossiness measurements were carried out using an ETB-0833 model gloss meter device at three distinct angles (20°, 60°, and 85°) in both perpendicular and parallel orientations to the fibers, by the ISO 2813 (1994) standard.

2.2.4 Determination of color properties

The alteration in color of the samples was quantified using a CS-10 device (CHN Spec, China) based on the CIELAB color system, in accordance with the ASTM D 2244-3 (2007) standard. The overall color difference results were calculated using the following formulas.

$$h^o = arctan\ (b^*/a^*) \quad (1)$$

$$C^* = [(a^*)^2 + (b^*)^2]^{0.5} \quad (2)$$

$$\Delta b^* = (b^*_{test\ sample\ with\ oil\ treatment} - b^*_{test\ sample\ without\ oil\ treatment}) \quad (3)$$

$$\Delta C^* = (C^*_{test\ sample\ with\ oil\ treatment} - C^*_{test\ sample\ without\ oil\ treatment}) \quad (4)$$

$$\Delta a^* = (a^*_{test\ sample\ with\ oil\ treatment} - a^*_{test\ sample\ without\ oil\ treatment}) \quad (5)$$

$$\Delta L^* = (L^*_{test\ sample\ with\ oil\ treatment} - L^*_{test\ sample\ without\ oil\ treatment}) \quad (6)$$

$$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{0.5} \quad (7)$$

$$\Delta H^* = [(\Delta E^*)^2 - (\Delta L^*)^2 - (\Delta C^*)^2]^{0.5} \quad (8)$$

The standards for assessing Δ*E** values can be found in Table 2, as detailed by Barański et al. (2017).

Table 2. Comparison criteria for Δ*E** value (Barański et al., 2017)

Color change criteria	**Δ*E** value**
Invisible color change	$\Delta E^* < 0.2$
Slight change of color	$2 > \Delta E^* > 0.2$
Color change visible in high filter	$3 > \Delta E^* > 2$
A color change visible with the average quality of the filter	$6 > \Delta E^* > 3$
High color change	$12 > \Delta E^* > 6$
Different color	$\Delta E^* > 12$

In accordance with the definitions of Δ*C**, Δ*H**, Δ*b**, Δ*a**, and Δ*L**: Δ*L** indicates a difference in lightness. A positive value suggests that the sample is lighter than the reference, whereas a negative value implies that the sample is darker than the reference. Δ*C**,denotes the difference in chroma or saturation. A positive value indicates that the sample is more vibrant or saturated than the reference, while a negative value suggests that the sample is less vibrant or saturated than the reference. In relation to Δ*b**, a positive value indicates that the sample is more yellow than the reference, whereas a negative value suggests that the sample is bluer than the reference. Δ*H** represents the difference in hue or shade. Δ*H** is reported as the tonal disparity between the sample and the reference. Δ*a**, the variation of a* parameter a positive value means that the sample is redder than the reference, while a negative value indicates that the sample is greener (Lange, 1999).

2.3 Statistical Analysis

The collected data underwent analysis using an SPSS program to ascertain the minimum and maximum values, homogeneity groups, standard deviations, percentage change rates, variance analysis, and multiple comparisons.

3 Results and Discussion

Table 3 presents the results of the multivariate analysis of variance. The glossiness test at 20 degrees in the perpendicular direction to the fibers was inconclusive in terms of statistical significance, whereas all other tests yielded significant results (Table 3).

Table 3. Multivariate analysis of variance results

Test	Sum of Squares	df	Mean Square	F	Sig.
Lightness (L^*) value	2933.275	4	733.319	1496.021	0.000*
Red (a^*) color tone value	89.827	4	22.457	35.838	0.000*
Yellow (b^*) color tone value	651.104	4	162.776	223.580	0.000*
Chroma (C^*) value	583.491	4	145.873	114.437	0.000*
Hue (h^o) angle value	2104.488	4	526.122	355.919	0.000*
Glossiness value at ⊥20°	0.320	4	0.080	.	.
Glossiness value at ⊥60°	16.949	4	4.237	520.980	0.000*
Glossiness value at ⊥85°	93.087	4	23.272	239.477	0.000*
Glossiness value at ‖20°	0.303	4	0.076	162.429	0.000*
Glossiness value at ‖60°	14.514	4	3.628	207.739	0.000*
Glossiness value at ‖85°	141.237	4	35.309	192.619	0.000*
Whiteness index in the perpendicular (⊥) direction	194.321	4	48.580	555.273	0.000*
Whiteness index in the parallel (‖) direction	147.962	4	36.991	1940.061	0.000*

*: Significant

The outcomes concerning the overall color variations are displayed in Table 4. The treatment with all waste oils on wooden surfaces resulted in negative ΔL^* (darker than the reference), Δb^* (bluer than the reference), and ΔC^* (duller, more turbid than the reference) values. In the case of Δa^* values, applications related to waste sunflower and olive oils resulted in positive (redder) values, while applications associated with waste corn and walnut oils were found to be negative (greener). In addition, when looking at the ΔE^* values, they were found to be 19.18 for sunflower, 22.02 for walnut, 22.65 for corn, and 19.49 for olive. When comparing the ΔE^* results obtained in this study with the color change table provided by Barański et al., 2017, it was observed that all vegetable waste oils were categorized under the 'Different color' category (Table 4).

Table 4. The results for total color differences

Waste Oil Type	ΔL^*	Δa^*	Δb^*	ΔC^*	ΔH^*	ΔE^*	Color change criteria (Barański et al., 2017)
Sunflower	-18.05	0.65	-6.46	-5.26	3.81	19.18	Different color (ΔE^*>12)
Walnut	-20.02	-1.69	-9.00	-8.69	2.87	22.02	
Corn	-20.00	-1.42	-10.53	-9.73	4.26	22.65	
Olive	-18.00	1.93	-7.21	-5.01	5.53	19.49	

The color, glossiness, and whiteness index (*WI**) results determined before and after the application of vegetable waste oils are presented in Table 5. According to these results, *L**, *C**, *b**, and h^o parameters decreased with all vegetable waste oils. The highest result for the *L** value was obtained in the control test samples (49.60), while the lowest was observed in the experiment samples treated with waste walnut oil (29.58).

The samples treated with waste walnut oil exhibited the most significant decrease in the *L** value, recording a reduction rate of 40.36%. On the contrary, the samples treated with waste olive oil showed the least decrease, with only a 36.29% reduction. For the *a** value, the lowest result was determined in the samples treated with waste olive oil (6.53), while the highest was obtained in the experiment samples treated with waste olive oil (10.15). When looking at the *a** parameter, increases were observed after the application of waste sunflower oil (7.91%) and olive oil (23.48%), while decreases were determined following the application of waste corn oil (17.27%) and walnut oil (20.56%).

As for the *b** value, the highest result was found in the control test samples (18.28), while the lowest was determined in the experiment samples treated with waste corn oil (7.75). The highest reduction rate for *b** was achieved in the samples treated with waste corn oil, with a percentage decrease of 57.60%, while the lowest reduction rate was determined in the samples treated with waste sunflower oil, with a decrease of only 35.34%.

*C** values were higher for control test samples with 20.05, whereas the experiment samples treated with waste corn oil exhibited the lowest value at 10.31. The samples treated with waste olive oil exhibited the least pronounced reduction rate, indicating a decline of 25.04%. The samples that underwent waste corn oil treatment had the most prominent reduction rate. They had a substantial drop of 48.58%.

Regarding the h^o values, the highest outcome was observed in the control test samples, registering at 65.78, while the lowest value was recorded in the experiment samples treated with waste corn oil, which amounted to 47.51. The samples treated with waste olive oil exhibited the most substantial reduction rate for h^o, registering a percentage decrease of 27.77%, while the experiment samples treated with waste walnut oil showed the smallest reduction rate, experiencing only a 16.51% decrease (Table 5).

There were decreases observed in *WI** values and glossiness values in all degrees and directions as a result of the application of all waste oils. The highest results for glossiness values were found in the control samples for all angles and fiber orientations. In general, the lowest glossiness values were observed on surfaces treated with waste olive oil. When *WI** values were examined, decreases were obtained in both perpendicular and parallel directions for all vegetable waste oils. The highest *WI** values were detected in the control experimental group samples for both fiber directions. Measurement results in the perpendicular direction to the fibers in *WI** values were found to be higher than those in the parallel direction. When looking at the reduction rates in *WI** values, it was determined that the reduction rates in the parallel direction to the fibers were higher than those in the perpendicular direction (Table 5).

Table 6 illustrates the comparison between studies conducted on waste vegetable oils in the literature and the results obtained in this study. From the given table, it’s evident that applying various oils to different wood species resulted in different outcomes in the same color parameters. This variability can be attributed to the inherent structure of the wood material.

Table 5. Results for whiteness index (*WI**), color, and glossiness values

Test	Waste Oil Type	N	Mean	Change (%)	Homogeneity Group	Standard Deviation	Coefficient of Variation	Mini-mum	Maxi-mum
*L**	Control	10	49.60	-	A*	0.24	0.49	49.22	49.91
	Sunflower	10	31.55	↓36.39	B	1.07	3.38	30.27	33.01
	Walnut	10	29.58	↓40.36	C**	0.91	3.09	28.77	31.44
	Corn	10	29.60	↓40.32	C	0.40	1.36	29.14	30.38
	Olive	10	31.60	↓36.29	B	0.51	1.61	30.39	32.05
*a**	Control	10	8.22	-	B	0.15	1.88	8.02	8.55
	Sunflower	10	8.87	↑7.91	B	1.23	13.83	7.51	10.87
	Walnut	10	6.53	↓20.56	C**	0.92	14.08	5.33	8.08
	Corn	10	6.80	↓17.27	C	0.54	7.95	6.05	7.76
	Olive	10	10.15	↑23.48	A*	0.68	6.73	8.78	11.25
*b**	Control	10	18.28	-	A*	0.31	1.68	17.80	18.63
	Sunflower	10	11.82	↓35.34	B	1.25	10.59	10.27	13.41
	Walnut	10	9.28	↓49.23	C	1.14	12.31	8.08	11.53
	Corn	10	7.75	↓57.60	D*	0.65	8.38	6.85	9.06
	Olive	10	11.07	↓39.44	B	0.50	4.54	9.90	11.59
*C**	Control	10	20.05	-	A*	0.33	1.63	19.53	20.38
	Sunflower	10	14.78	↓26.28	B	1.72	11.61	12.73	17.09
	Walnut	10	11.35	↓43.39	C	1.43	12.61	9.68	14.08
	Corn	10	10.31	↓48.58	D**	0.82	7.99	9.14	11.93
	Olive	10	15.03	↓25.04	B	0.77	5.12	13.24	15.85
h°	Control	10	65.78	-	A*	0.29	0.44	65.15	66.14
	Sunflower	10	53.19	↓19.14	C	1.35	2.55	50.48	55.50
	Walnut	10	54.92	↓16.51	B	1.60	2.91	52.32	56.79
	Corn	10	48.71	↓25.95	D	1.07	2.20	46.80	50.62
	Olive	10	47.51	↓27.77	E**	1.33	2.79	44.78	49.22
⊥20°	Control	10	0.30	-	A*	0.00	0.00	0.30	0.30
	Sunflower	10	0.10	↓66.67	B**	0.00	0.00	0.10	0.10
	Walnut	10	0.10	↓66.67	B**	0.00	0.00	0.10	0.10
	Corn	10	0.10	↓66.67	B**	0.00	0.00	0.10	0.10
	Olive	10	0.10	↓66.67	B**	0.00	0.00	0.10	0.10
⊥60°	Control	10	2.50	-	A*	0.12	4.62	2.30	2.60
	Sunflower	10	1.26	↓49.60	B	0.13	10.04	1.10	1.40
	Walnut	10	0.95	↓62.00	C	0.05	5.55	0.90	1.00
	Corn	10	1.18	↓52.80	B	0.08	6.68	1.10	1.30
	Olive	10	0.93	↓62.80	C**	0.05	5.19	0.90	1.00
⊥85°	Control	10	5.86	-	A*	0.54	9.21	5.10	6.50
	Sunflower	10	3.32	↓43.34	B	0.17	5.08	3.10	3.50
	Walnut	10	2.59	↓55.80	C	0.24	9.36	2.30	2.90
	Corn	10	2.76	↓52.90	C	0.29	10.42	2.40	3.20
	Olive	10	1.90	↓67.58	D**	0.16	8.23	1.70	2.10
‖20°	Control	10	0.30	-	A*	0.00	0.00	0.30	0.30
	Sunflower	10	0.13	↓56.67	B	0.05	37.16	0.10	0.20
	Walnut	10	0.10	↓66.67	C**	0.00	0.00	0.10	0.10
	Corn	10	0.10	↓66.67	C**	0.00	0.00	0.10	0.10
	Olive	10	0.10	↓66.67	C**	0.00	0.00	0.10	0.10
‖60°	Control	10	2.64	-	A*	0.17	6.49	2.40	2.80
	Sunflower	10	1.77	↓32.95	B	0.16	9.25	1.60	2.00
	Walnut	10	1.28	↓51.52	CD	0.10	8.07	1.20	1.40
	Corn	10	1.32	↓50.00	C	0.08	5.98	1.20	1.40
	Olive	10	1.19	↓54.92	D**	0.12	10.06	1.10	1.40
‖85°	Control	10	6.86	-	A*	0.20	2.85	6.70	7.20
	Sunflower	10	5.99	↓12.68	B	0.75	12.55	5.20	6.70
	Walnut	10	3.58	↓47.81	C	0.49	13.73	2.70	3.90
	Corn	10	3.96	↓42.27	C	0.26	6.65	3.70	4.30
	Olive	10	2.22	↓67.64	D**	0.04	1.90	2.20	2.30
*WI** (⊥)	Control	10	8.78	-	A*	0.61	7.00	8.00	9.70
	Sunflower	10	4.12	↓53.08	B	0.08	1.91	4.00	4.20
	Walnut	10	3.55	↓59.57	C**	0.19	5.35	3.30	3.80
	Corn	10	4.12	↓53.08	B	0.10	2.51	4.00	4.20
	Olive	10	3.74	↓57.40	C	0.08	2.25	3.70	3.90
*WI** (‖)	Control	10	4.50	-	A*	0.29	6.46	4.10	4.90
	Sunflower	10	0.25	↓94.44	B	0.05	21.08	0.20	0.30
	Walnut	10	0.20	↓95.56	B	0.00	0.00	0.20	0.20
	Corn	10	0.19	↓95.78	B	0.07	38.83	0.10	0.30
	Olive	10	0.16	↓96.44	B**	0.05	32.27	0.10	0.20

N: Number of Measurements, *: Highest, **: Lowest Value

Table 6. Comparison of studies conducted on waste vegetable oils

Wood Type	Oil type	Change after Application					Reference
		L*	***a****	***b****	**C***	***h*º**	
American walnut (*Juglans nigra* L.)	Sunflower	↓	↑	↓	↓	↓	This study
	Walnut	↓	↓	↓	↓	↓	
	Corn	↓	↓	↓	↓	↓	
	Olive	↓	↑	↓	↓	↓	
European larch (*Larix decidua* Mill.)	Olive	↑	↓	↓	↓	↑	Ayata ve Bal, (2023)
	Walnut	↑	↓	↓	↓	↑	
	Corn	↑	↓	↓	↓	↑	
Bamboo (*Phyllostachys* spp.)	Sunflower	↓	↑	↑	↑	↓	Peker, (2023b)
	Walnut	↓	↑	↑	↑	↓	
	Corn	↓	↑	↑	↑	↓	
	Olive	↓	↑	↑	↑	↓	
Scots pine (*Pinus sylvestris* L.)	Walnut	↓	↑	↑	↑	↑	Peker, (2023a)
	Corn	↓	↑	↑	↑	↑	
	Olive	↓	↑	↑	↑	↑	
Common pear (*Pyrus communis* L.)	Sunflower	↓	↑	↑	↑	↓	Çamlıbel and Ayata, (2023a)
	Walnut	↓	↑	↑	↑	↓	
	Corn	↓	↑	↑	↑	↓	
	Olive	↓	↑	↑	↑	↓	
Tiama (*Entandrophragma angolense*)	Sunflower	↓	↓	↓	↓	↓	Çamlıbel and Ayata, (2023b)
	Walnut	↓	↓	↓	↓	↓	
	Corn	↓	↓	↓	↓	↓	
	Olive	↓	↓	↓	↓	↓	
Black locust (*Robinia pseudoacacia* L.)	Walnut	↓	↑	↑	↑	↓	Çamlıbel and Ayata, (2023c)
	Corn	↓	↑	↑	↑	↓	
	Olive	↓	↑	↑	↑	↓	
Anatolian chestnut (*Castanea sativa* Mill.)	Walnut	↓	↑	↑	↑	↓	Peker and Ulusoy, (2023)
	Corn	↓	↑	↑	↑	↓	
	Olive	↓	↑	↑	↑	↓	

4. Conclusion

- Upon reviewing the research findings, it became evident that the multivariate analysis of variance tests conducted for *WI** values and color parameters yielded statistically significant results.
- A decrease in *L**, *C**, *h*º, and *b** parameters, *WI** values, and glossiness values for all degrees and orientations were identified as a result of all vegetable waste oils.
- The Δ*E** values were recorded as 19.18 for sunflower, 22.02 for walnut, 22.65 for corn, and 19.49 for olive.
- It was noticeable that each of the discarded vegetable oils influenced the color changes of the wooden surface.
- It is suggested that wood treated with waste vegetable oils would be suitable for outdoor use.

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Hüseyin Peker: Conceptualization (Developing research ideas and objectives), Data curation, **Bruno Esteves:** Visualization, Writing – original draft, Writing – review & editing, **Ümit**

Ayata: Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, and Validation.

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