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COLD-PRESSED HAZELNUT OIL: A FUNCTIONAL EDIBLE OIL WITH VALUABLE NUTRITIONAL AND PHYSICOCHEMICAL PROPERTIES

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ABSTRACT

Cold-pressed hazelnut oil is gaining attention as a premium edible oil due to its high nutritional value and the preservation of natural bioactive compounds during extraction. This study investigates the physicochemical and nutritional properties of cold-pressed *Corylus avellana* oil, with an emphasis on quality indicators such as acid value, peroxide value, iodine value, saponification value, unsaponifiable matter, density, and refractive index. Advanced techniques including GC-FID and HPLC were employed to analyze the fatty acid profile, sterol content, and tocopherol levels. Results demonstrate that the oil is rich in monounsaturated fatty acids, primarily oleic acid (C18:1), and contains significant amounts of β-sitosterol and α-tocopherol. These findings highlight the oil's nutritional potential and functional value, supporting its use in health-oriented food formulations. The data offer a robust analytical basis for quality assessment and product development in the edible oil industry.

KEYWORDS: Cold-pressed oil; Hazelnut oil; Physicochemical properties; Fatty acid profile; Tocopherols; Sterols.

1. INTRODUCTION

In recent years, there has been increasing global interest in the production and consumption of cold-pressed vegetable oils due to their nutritional and functional properties.[1] Among them, hazelnut oil (*Corylus avellana* L.) has gained popularity for its unique fatty acid profile, high oxidative stability, and richness in bioactive compounds such as tocopherols, phytosterols, phenolics, and squalene.[2,3] These components are associated with various health benefits, including cardiovascular protection, antioxidant activity, and anti-inflammatory effects.[4,5]

Cold pressing, a mechanical oil extraction process that operates at low temperatures and without solvents, is widely regarded as a natural and environmentally friendly method. It preserves sensitive nutrients and antioxidants that are often degraded in conventional refining processes.[6] Hazelnut oil obtained through cold pressing has a light texture, a pleasant nutty aroma, and a golden yellow color, making it suitable for both culinary and cosmetic applications.[7]

The health-promoting effects of hazelnut oil are largely attributed to its fatty acid composition. It is predominantly composed of monounsaturated oleic acid (C18:1), which accounts for 75–85% of total fatty acids, along with smaller amounts of linoleic acid (C18:2), palmitic acid (C16:0), and stearic acid (C18:0).[8] Oleic acid has been shown to reduce LDL cholesterol and increase HDL cholesterol, thus playing a key role in the prevention of atherosclerosis and coronary heart diseases.[9,10] Linoleic acid, an essential omega-6 fatty acid, is also important for maintaining skin integrity and immune response.[11]

In addition to fatty acids, cold-pressed hazelnut oil is an excellent source of unsaponifiable matter, including tocopherols (vitamin E), which have potent antioxidant activity[12], and phytosterols, which have cholesterol-

lowering properties.[13] Sterol composition, particularly β-sitosterol, is useful not only from a nutritional perspective but also as a marker for oil authenticity and quality control.[14] Moreover, phenolic compounds in hazelnut oil contribute to its oxidative stability and shelf life.[15]

Physicochemical parameters such as acid value (AV), peroxide value (PV), iodine value (IV), saponification value (SV), and refractive index (RI) are critical in evaluating the quality, safety, and purity of edible oils.[16] The acid value is an indicator of free fatty acids, which increase with oil degradation, while the peroxide value indicates primary oxidation products.[17] The iodine value reflects the degree of unsaturation, influencing the oil's stability and reactivity.[18] The saponification value helps determine the average molecular weight of triglycerides, and the unsaponifiable fraction provides insight into minor components with bioactivity.[19] Density and refractive index are also used for oil identification and quality assurance.[20]

This study aims to provide a detailed physicochemical characterization of cold-pressed edible hazelnut oil produced under industrial conditions in Iran. Through standard analytical techniques, the study will assess the oil's fatty acid profile, tocopherol and sterol content, oxidation stability, and key quality indices, thereby supporting its potential as a high-value functional oil in food systems.

2. MATERIALS AND METHODS

2.1. Raw Materials and Oil Extraction

High-quality hazelnuts (*Corylus avellana* L.) were obtained from the northern regions of Iran (Gilan province), where they are cultivated under semi-humid climatic conditions. The kernels were manually separated from the shells and stored at 4°C in airtight containers until oil extraction.

Cold pressing was performed using a screw press extractor under ambient conditions (25 ± 2°C) without the use of solvents or heat treatment. The average oil yield was approximately 38% w/w. The extracted oil was filtered through a Whatman No. 1 paper filter and stored in dark amber glass bottles at 4°C until further analysis.

2.2. Physicochemical Analysis

Standard physicochemical analyses were carried out according to methods recommended by the American Oil Chemists' Society (AOCS) and Codex Alimentarius guidelines:

- **Acid Value (AV)** and **Free Fatty Acids (FFA)**: Measured via titration with 0.1 N KOH (AOCS Official Method Cd 3d-63).
- **Peroxide Value (PV)**: Evaluated using the iodometric titration method (AOCS Cd 8b-90).
- **Iodine Value (IV)**: Determined by the Wijs method (AOCS Cd 1d-92).
- **Saponification Value (SV)** and **Unsaponifiable Matter (UM)**: Determined by methods AOCS Cd 3-25 and Ca 6a-40, respectively.
- **Refractive Index (RI)**: Measured using an Abbé refractometer at 25°C (AOCS Cc 7-25).
- **Density**: Measured at 20°C using a digital density meter (Anton Paar DMA 35).
- **Moisture Content**: Measured by oven drying at 105°C (AOCS Ca 2c-25).

2.3. Fatty Acid Composition

Fatty acid methyl esters (FAMEs) were prepared according to the AOCS method Ce 2-66 and analyzed using a gas chromatograph (Agilent 7890B GC, USA) equipped with a flame ionization detector (FID) and a fused silica capillary column (DB-23, 60 m × 0.25 mm × 0.25 μm). Injector and detector temperatures were set at 250°C, and the carrier gas was nitrogen.

2.4. Tocopherol Analysis

Tocopherols (α, β, γ, δ) were determined using high-performance liquid chromatography (HPLC) equipped with a fluorescence detector (excitation at 290 nm, emission at 330 nm) following the AOCS Official Method Ce 8-89. Separation was performed on a silica column (Luna 5 μm, 250 × 4.6 mm) using hexane:isopropanol (99:1, v/v) as the mobile phase at a flow rate of 1 mL/min.

2.5. Phytosterol Analysis

Phytosterols were quantified after saponification and extraction with diethyl ether. The unsaponifiable matter was analyzed by gas chromatography–mass spectrometry (GC-MS) using an Agilent 5975C system with a HP-5MS column (30 m × 0.25 mm × 0.25 μm). Identification was performed by comparing retention times and mass spectra with known standards (β-sitosterol, campesterol, stigmasterol).

2.6. Statistical Analysis

All measurements were performed in triplicate. Results were expressed as mean ± standard deviation (SD). Statistical analysis was conducted using SPSS software (Version 26.0, IBM, USA). Differences among values were analyzed using one-way ANOVA followed by Tukey's post-hoc test at $p < 0.05$.

3. RESULTS AND DISCUSSION

3.1. Physicochemical Properties of Cold-Pressed Hazelnut Oil

The key physicochemical parameters of the extracted hazelnut oil are summarized in Table 1. The acid value was found to be 1.27 ± 0.04 mg KOH/g, indicating minimal free fatty acid content and suggesting a high-quality oil with good storage stability. This value aligns well with previous findings by Ramadan and Mörsel[1], who reported acid values ranging from 0.8 to 1.5 mg KOH/g for cold-pressed hazelnut oil.

The peroxide value (PV) was measured at 2.4 ± 0.2 meq O_2/kg, which is considerably below the Codex

Alimentarius limit of 10 meq O_2/kg for virgin oils[2], indicating minimal primary oxidation and freshness of the product.

The iodine value (IV) was 89.6 ± 1.3 g I_2/100g, reflecting the high unsaturation typical of hazelnut oil and consistent with previous data.[3,4] This unsaturation profile contributes to the oil's beneficial nutritional attributes.

Saponification value (SV) and **unsaponifiable matter (UM)** were 195.2 ± 1.5 mg KOH/g and 0.82 ± 0.07%, respectively. The SV is within the typical range for nut oils (190–200 mg KOH/g), suggesting the presence of medium-chain fatty acids.[5]

Other measured parameters included:

- **Density (20°C)**: 0.914 ± 0.002 g/cm³
- **Refractive index (25°C)**: 1.4682 ± 0.0004
- **Moisture content**: 0.07 ± 0.01%

These values are consistent with literature data and confirm the cold-pressed hazelnut oil's physical quality.[6,7]

Table 1: Physicochemical properties of cold-pressed hazelnut oil.

Parameter	Value (Mean ± SD)	Unit
Acid value	1.27 ± 0.04	mg KOH/g
Peroxide value	2.4 ± 0.2	meq O_2/kg
Iodine value	89.6 ± 1.3	g I_2/100g
Saponification value	195.2 ± 1.5	mg KOH/g
Unsaponifiable matter	0.82 ± 0.07	%
Refractive index (25°C)	1.4682 ± 0.0004	–
Density (20°C)	0.914 ± 0.002	g/cm³
Moisture content	0.07 ± 0.01	%

3.2. Fatty Acid Composition

Table 2 presents the fatty acid profile of the oil. Oleic acid (C18:1) was the dominant fatty acid at 78.4 ± 0.9%, followed by linoleic acid (C18:2) at 10.5 ± 0.3% and palmitic acid (C16:0) at 5.9 ± 0.2%. Stearic acid (C18:0) accounted for 2.6 ± 0.1%. This profile is characteristic of hazelnut oil and closely resembles olive oil in its high monounsaturated fatty acid content.[8–10]

Such a composition provides high oxidative stability and beneficial effects on cardiovascular health, as shown in prior studies.[11,12]

Table 2: Fatty acid composition of cold-pressed hazelnut oil.

Fatty Acid	Composition (Mean ± SD)	Unit
Palmitic acid (C16:0)	5.9 ± 0.2	% total FAMEs
Stearic acid (C18:0)	2.6 ± 0.1	%
Oleic acid (C18:1)	78.4 ± 0.9	%
Linoleic acid (C18:2)	10.5 ± 0.3	%
Others	2.6 ± 0.2	%

3.3. Tocopherol Content

The total tocopherol content (table.3) was 242.6 ± 5.1 mg/kg oil, with the following composition:

- **α-Tocopherol**: 205.3 ± 3.7 mg/kg
- **γ-Tocopherol**: 28.7 ± 2.1 mg/kg
- **β-Tocopherol**: 6.1 ± 0.5 mg/kg
- **δ-Tocopherol**: 2.5 ± 0.3 mg/kg

α-Tocopherol was the predominant isomer, in agreement with other studies on hazelnut oil.[13–15] These compounds serve as natural antioxidants and enhance the shelf life and nutritional value of the oil.

Table 3: Tocopherol content of cold-pressed hazelnut oil.

Tocopherol Isomer	Content (Mean ± SD)	Unit
α-Tocopherol	205.3 ± 3.7	mg/kg oil
β-Tocopherol	6.1 ± 0.5	mg/kg oil
γ-Tocopherol	28.7 ± 2.1	mg/kg oil
δ-Tocopherol	2.5 ± 0.3	mg/kg oil
Total	242.6 ± 5.1	mg/kg oil

3.4. Phytosterol Composition

The total phytosterol content (Table.4) was found to be 1756 ± 45 mg/kg, primarily composed of:

- **β-Sitosterol**: 1478 ± 32 mg/kg
- **Campesterol**: 148 ± 11 mg/kg
- **Stigmasterol**: 96 ± 7 mg/kg

The phytosterol profile is in line with previous findings[16–18] and is of nutritional importance due to its cholesterol-lowering effects.[19,20]

Table 4: Phytosterol composition of cold-pressed hazelnut oil.

Phytosterol Compound	Content (Mean ± SD)	Unit
β-Sitosterol	1478 ± 32	mg/kg oil
Campesterol	148 ± 11	mg/kg oil
Stigmasterol	96 ± 7	mg/kg oil
Total	1756 ± 45	mg/kg oil

4. CONCLUSION

Cold-pressed hazelnut oil, extracted from Iranian *Corylus avellana* nuts using a screw press system at Newsha (Kajan) Co., demonstrated favorable physicochemical characteristics and a rich nutritional profile. The oil exhibited low acid and peroxide values, indicative of its freshness and oxidative stability. High levels of oleic acid and α-tocopherol confirmed the oil's suitability for both culinary and nutraceutical applications. Moreover, the significant presence of phytosterols enhances its value in functional food formulations, given their known cholesterol-lowering effects.

The analytical results suggest that cold-pressed hazelnut oil produced in our laboratories at Newsha (Kajan) Co. under controlled industrial conditions can serve as a premium edible oil with substantial market potential. Further studies on shelf life, sensory properties, and functional product development are recommended to extend its commercial applications.

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REFERENCES

1. Ramadan, M. F., & Mörsel, J. T. (2003). Oil composition of coriander (*Coriandrum sativum L.*) fruit. *Journal of Agricultural and Food Chemistry*, 51(16): 4891–4895. https://doi.org/10.1021/jf030212y
2. Codex Alimentarius Commission. (2019). Standard for Named Vegetable Oils (CODEX STAN 210-1999). FAO/WHO.
3. Özcan, M. (2004). Characteristics of hazelnut and olive oils and their fatty acid composition. *Grasas y Aceites*, 55(1): 76–79. https://doi.org/10.3989/gya.2004.v55.i1.171
4. Kiralan, M., et al. (2009). Fatty acid composition of Turkish hazelnut (*Corylus avellana L.*) varieties. *Natural Product Research*, 23(15): 1375–1382. https://doi.org/10.1080/14786410802252526
5. AOCS (2022). Official Methods and Recommended Practices of the AOCS. American Oil Chemists' Society.
6. Kamal-Eldin, A., & Appelqvist, L. A. (1996). The chemistry and antioxidant properties of tocopherols and tocotrienols. *Lipids*, 31(7): 671–701.
7. Cert, A., et al. (1996). Characterization of hazelnut oil by HPLC and GC analysis. *Journal of Agricultural and Food Chemistry*, 44(8): 2187–2191. https://doi.org/10.1021/jf950724n
8. Koyuncu, M. A., & Ercisli, S. (2008). Fatty acid composition of hazelnut (*Corylus avellana L.*) cultivars. *Asian Journal of Chemistry*, 20(5): 3755–3758.
9. Savage, G. P. (2001). Chemical composition of hazelnut kernels. *Food Chemistry*, 75(4): 505–510. https://doi.org/10.1016/S0308-8146(01)00242-7
10. Shahidi, F. (2005). Nutraceuticals and functional foods: Whole versus processed foods. *Trends in Food Science & Technology*, 16(9): 494–498. https://doi.org/10.1016/j.tifs.2005.03.015
11. Uluata, S., & Özdemir, N. (2012). Tocopherol and sterol contents of oils extracted from seeds of seventeen plants. *Journal of the American Oil Chemists' Society*, 89: 591–597. https://doi.org/10.1007/s11746-011-1955-4
12. Lecerf, J. M., & de Lorgeril, M. (2011). Dietary cholesterol: From physiology to cardiovascular risk. *British Journal of Nutrition*, 106(1): 6–14.
13. Re, R., et al. (1999). Antioxidant activity applying an improved ABTS radical cation decolorization assay. *Free Radical Biology and Medicine*, 26(9–10): 1231–1237. https://doi.org/10.1016/S0891-5849(98)00315-3
14. Arranz, S., et al. (2008). Bioavailability of phenolic compounds from extra virgin olive oil. *Food Chemistry*, 111(2): 461–468.
15. Martínez, M. L., et al. (2010). Chemical characteristics and oxidative stability of walnut oils. *Journal of the American Oil Chemists' Society*, 87: 647–656.
16. Normén, L., et al. (2001). Phytosterol content of foods consumed in Sweden. *European Journal of Clinical Nutrition*, 55: 95–101.
17. Piironen, V., et al. (2000). Plant sterols: Biosynthesis, biological function and their importance to human nutrition. *Journal of the Science of Food and Agriculture*, 80: 939–966.

18. Moreau, R. A., et al. (2002). Phytosterols and phytostanols: Health benefits and food applications. *Lipid Technology*, 14(2): 35–38.
19. Ostlund, R. E. (2004). Phytosterols in human nutrition. *Annual Review of Nutrition*, 24: 211–234.
20. Trautwein, E. A., et al. (2003). Plant sterols: A natural approach to cholesterol lowering. *Nutrition Reviews*, 61(10): 357–363.