Journal of Pharmacology &Drug Development

eISSN: 2958-6801

OPEN ACCESS

Anti-angiogenic and Antioxidant Activities of Juglans Regia L. Green Husk: An Experimental Study using Rat Aortic Ring and CAM Assay

Abeer Sabir Aliwy [*,1], **Haydar Baha Sahib**[1]

[1] *Department of Pharmacology and Toxicology, College of Pharmacy, Al-Nahrain University, Baghdad, Iraq.*

***Corresponding author**

Received 27 Feb , Accepted 1 May , Published 1 Jun

ABSTRACT

Objective: Angiogenesis is the biological process that creates new capillary blood vessels from existing ones. This process is a big part of how tumors grow, spread, and spread to other parts of the body. The present study aimed to evaluate the anti-angiogenic and antioxidant activities of different extracts of J*uglans regia* L. green husk and to explore their potential therapeutic relevance.

Methods: The rat aortic ring angiogenesis experiment used albino male rats that were twelve to fourteen weeks old. The ethanolic extract of *Juglans regia* L. was prepared and solubilized in dimethyl sulfoxide (DMSO) to form a stock solution. The rat aortic ring assay was employed *ex vivo* to evaluate the anti-angiogenic characteristics of the plant extract.

Results: The aqueous extract showed the highest extraction yield (4.46%), followed by the ethanolic (2.15%) and chloroform extracts (1.9%). In the rat aortic ring assay, the ethanolic extract demonstrated the strongest anti-angiogenic activity (52.92% inhibition), followed by the aqueous (32.90%) and chloroform extracts (30.98%) compared with the negative control ($p < 0.05$). In the CAM assay, the ethanolic extract significantly reduced vascular density, producing approximately 65.4% inhibition of angiogenesis ($p < 0.05$). Furthermore, the ethanolic extract exhibited concentration-dependent antioxidant activity in the DPPH assay, with a maximum scavenging activity of 83.7% at 100 µg/mL and an IC_{50} value of approximately 23.3 µg/mL.

Conclusions: *Juglans regia* L. may represent a potential natural source of anti-angiogenic and antioxidant activity for the management of angiogenesis-related disorders.

Keywords: angiogenesis, CAM assay, Rat aortic ring assay, DPPH radical scavenging

INTRODUCTION

Vasculogenesis and angiogenesis are closely connected processes that work together to create new blood vessels.[(1)] Vasculogenesis is the process by which endothelial precursor cells develop into new blood vessels that ultimately make up the primary vascular plexus. The early phases of embryogenesis are when this process mostly occurs. Furthermore, a process called angiogenesis helps tissues grow, maintain, and change shape to adapt to changing needs. Under physiological circumstances, it entails the growth and alteration of the original vascular network and lasts throughout life. [(2,3)] Vasculogenesis is marked by the transformation of endothelial precursor cells, termed angioblasts, into endothelial cells and the genesis of a rudimentary vascular network. It happens when the circulatory system is still developing in the embryo. Specifically, adjacent to blood islands, which first develop in the mesoderm of the yolk sac at three weeks of gestation. Polyphenols are bioactive compounds prevalent in nature, renowned for their health-promoting properties. Medicinal plants, fruits, and vegetables are abundant in flavonoids, a category of

polyphenol recognized for various biological effects, including the protection of the heart and nervous system from damage. [4,5]

These traits have been associated with the management and prevention of various chronic diseases, including cancer and cardiovascular disorders. There is increasing evidence that flavonoids are important for controlling angiogenesis. [6] Flavonoids have been demonstrated in experimental studies to inhibit endothelial cell proliferation, migration, and tube formation by modulating critical pro-angiogenic signaling pathways, particularly those involving vascular endothelial growth factor (VEGF) and fibroblast growth factor (FGF). Flavonoids exhibit potential as natural anti-angiogenic agents by inhibiting pathological neovascularization and tumor-associated angiogenesis through the suppression of specific pathways. [7,8]

There are two types of angiogenesis sprouting and Intussusceptive angiogenesis. Sprouting angiogenesis is a step-by-step process begun by the activation of endothelial cells in already established capillaries in response to angiogenic signals. When endothelial cells are activated, they break down the basement membrane and move into the extracellular matrix nearby. This makes solid projections called endothelial sprouts. After these sprouts form lumens, they turn into hollow vessels that connect to nearby capillaries or venules and become part of the existing capillary network. Changes to the basement membrane and the addition of pericytes, which are support cells that surround the endothelial cells of small blood vessels, make the artery more stable and help it mature.[9,10] Intussusceptive angiogenesis, also known as splitting angiogenesis, happens when the vessel wall moves into the lumen, causing one vessel to split into two. This type of angiogenesis is thought to be faster and more efficient than sprouting angiogenesis because it only requires rearranging existing endothelial cells, rather than the immediate growth or movement of endothelial cells. Although intussusceptive angiogenesis occurs throughout life, it is especially important for forming blood vessels in embryos, where growth is rapid and resources are limited. Intussusception mainly helps create new capillaries in areas where capillaries already exist. A key feature of this process is the presence of transcapillary tissue pillars, which serve as structural indicators that confirm the occurrence of intussusceptive vessel growth. The process begins when the walls of a capillary, which are made of endothelial cells, touch each other and form junctions. These junctions then reorganize into small pillars inside the capillary. These new pillars are then infiltrated by pericytes and fibroblast-like cells. [9,11]

Juglans regia L., also known as the Persian or English walnut, belongs to the family Juglandaceae. The green husk (pericarp) is a non-edible by-product of walnut processing and has gained increasing scientific interest due to its high content of bioactive secondary metabolites. Traditionally considered agricultural waste, the green husk has emerged as a valuable source of pharmacologically active compounds with antioxidant, anti-inflammatory, antiproliferative, and vascular-modulating properties. The tree is found all over Europe, Asia, and parts of the Middle East. It does very well in temperate climates. It has a strong trunk and pinnate leaves that smell different from other plants. The fruit of *J. regia* L.is a drupe with a hard-shelled nut inside a green husk on the outside. The green husk (pericarp) represents a rich source of bioactive compounds that have attracted considerable attention due to their potential pharmacological applications. [12,13]

Nevertheless, despite the reported antioxidant and anti-inflammatory properties of *Juglans regia* L., its direct anti-angiogenic activity has not been thoroughly investigated using well-established angiogenesis models. Therefore, the present study was designed to evaluate the anti-angiogenic and antioxidant effects of various *Juglans regia* L. extracts by employing extraction procedures, the rat aortic assay screening as an *ex vivo* model, the chick chorioallantoic membrane assay for vascular density assessment as *in vivo* model, and the DPPH radical scavenging assay to determine antioxidant capacity.

Materials and Methods

Plant collection and authentication

In April 2025, mature walnut fruits were harvested from the mountainous regions of Sulaymaniyah, Iraq, resulting in 500 g of fresh, nutritious green husks of *Juglans regia* L. The plant material was authenticated by the AL-Razi Center for Alternative Medicine (Ministry of Health, Iraq) and confirmed as *Juglans regia* L. (family: Juglandaceae). Only healthy, fully matured, and disease-free green husks were selected for further testing.

Extraction Method

Fresh green husks of *Juglans regia* L. were carefully washed with running tap water and air-dried at 40–45 °C until they reached a stable weight. A mechanical grinder was used to turn the dried substance into a fine powder.

A total of 130 g of powdered husk underwent sequential hot extraction utilizing a Soxhlet apparatus with solvents of ascending polarity: chloroform, 70% ethanol, and distilled water, each solvent being used in a volume of approximately 2000 mL. After extraction, the mixtures were filtered through Whatman No. 1 filter paper. Using a rotary evaporator, the filtrates were concentrated under lower pressure to get the crude extracts. The dried extracts were weighed to determine the extraction yield, and then they were stored in airtight containers at 4 °C for later use.

Experimental Animals

This study employed male Sprague-Dawley rats aged 12-14 weeks. The animals were obtained from the animal facility of the Institute of Embryo Research and Infertility Treatment at Al-Nahrain University. The rats were housed under a standard laboratory environment (25±2 °C) and had free access to food and water. All procedures were conducted in accordance with institutional ethical standards.

Anti-angiogenesis assessment using *Ex Vivo* Rat Aortic Ring model

The ethanolic extract of *Juglans regia* L. was evaluated for its ability to stop angiogenesis using the rat aortic ring test with some changes to standard procedures. The rats were euthanized under appropriate anesthesia, and the thoracic aorta was carefully removed and cleaned of any connective tissues that were nearby.
The aorta was cut into rings that were approximately 1 mm in thickness. Each ring was put into a 48-well plate with fibrin gel and allowed to harden. Then, M199 medium with fetal bovine serum and antibiotics was given. The extract was dissolved in 1% DMSO, diluted to a final concentration of (100 µg/mL) and applied to the rings. DMSO (1%) served as the negative control, while suramin (100 µM) served as the positive control.

The plates were kept in a humidified incubator at 37 °C with 5% CO_2 for five days. Microvessel outgrowth was examined under a light microscope and quantified by measuring the radial outgrowth of microvessels from the aortic ring. The data were expressed as mean ± standard deviation (SD).

The percentage of blood vessel inhibition was calculated using the following equation:

$$\text{Percentage of blood vessel inhibition (\%)} = [1 - (A_0 / A)] \times 100$$

Where:

A_0 = mean microvessel growth in treated rings
A = mean microvessel growth in negative control rings

Chick Chorioallantoic Membrane (CAM) Assay

The CAM assay was performed using a standard protocol with minor modifications. Fertilized chicken eggs were sterilized with 70% ethanol and incubated horizontally at 37 °C with 60–70% relative humidity. Day 0 was considered the first day of incubation.

On day 4, approximately 2 mL of albumin was aseptically taken out of the blunt end of each egg to detach the CAM.
On day 7, the eggshell was carefully fenestrated to expose the CAM. Sterile filter paper discs (5 mm in diameter), pre-soaked with 50 µL of the ethanolic extract of *Juglans regia* L., were carefully placed onto the membrane surface. The control group received 1% DMSO. Six eggs were used per group (n = 6).
After 48 hours of incubation, CAM images were taken with an inverted microscope at low magnification and standardized lighting conditions.
Branching blood vessels growing toward the filter disc were counted within a defined circular area around the disc to measure angiogenesis. To keep the samples consistent, all CAM images used the same size region. Images were analyzed using ImageJ software (National Institutes of Health, USA). The data were expressed as mean ± standard deviation (SD).

The percentage inhibition of angiogenesis was determined using the following formula:

$$\text{Inhibition (\%)} = [1 - (T/C)] \times 100$$

Where:

T = mean vessel count of treated group
C=mean vessel count of the control group

2,2-Diphenyl-1-picrylhydrazyl (DPPH) Radical Scavenging Activity Assay

The antioxidant activity of *Juglans regia* L. green husk extract was evaluated using standard DPPH free radical scavenging assay with minor modifications.

A 0.1 mM DPPH solution was freshly prepared in methanol and protected from light**.** A stock solution of *Juglans regia* L. extract was prepared by diluting 100 µL of the extract with 990 µL of methanol to obtain a final volume of 1 mL. Serial dilutions were then prepared from the stock solution to yield concentrations of 100, 50, 25, 12.5, 6.25, and 3.125 µg/mL.

The assay was carried out in 96-well microplates by adding 100 µL of each extract concentration to 200 µL of the DPPH solution. Methanol alone served as the blank, while methanol mixed with the DPPH solution served as the negative control. All experiments were performed in triplicate. Plates were gently mixed and incubated at room temperature in the dark for 30 minutes.

Absorbance was measured at 517 nm using an ELISA microplate reader. The decrease in absorbance indicated the scavenging of DPPH radicals by antioxidant constituents in the extract.

The percentage of DPPH radical scavenging activity was calculated according to the following equation:

$$Scavenging\ activity\ (\%) = \frac{A_0 - A_1}{A_0} \times 100$$

Where; $A_0$is the absorbance of the control (DPPH solution without sample) and

$A_1$is the absorbance of the sample after reaction with DPPH.

Statistical analysis:

Results were expressed as mean ± standard deviation. Statistical comparisons among groups were conducted using one-way analysis of variance (ANOVA), followed by Tukey's post hoc test for multiple comparisons. The value of $P < 0.05$ was considered statistically significant. IC_{50} values were determined through both linear and logarithmic regression analyses. All statistical computations were performed using SPSS software (version 21.0).

RESULTS

Extraction Yield of *Juglans regia* L. Green Husk

Sequential extraction of *Juglans regia* L. green husk produced three crude extracts with different yields depending on the solvent polarity. As shown in **Table 1**, the aqueous extract exhibited the highest yield (4.46%), followed by the ethanolic extract (2.15%), whereas the chloroform extract showed the lowest yield (1.9%).

Table 1: Weight and extraction yield of crude extracts obtained from *Juglans regia* L. green husks

Type of extract	Weight of crude extract(gm)	Yield (%)
Chloroform	**2.5**	**1.9**
Ethanol	**2.8**	**2.15**
Water	**5.8**	**4.46**

Anti-angiogenic Activity in the Rat Aortic Ring Assay

The anti-angiogenic activity of chloroform, ethanolic, and aqueous extracts of Juglans regia L. green husk at a concentration of 100 µg/mL was evaluated using the rat aortic assay (Figure 1). As summarized in Table 2, all extracts significantly inhibited microvessel growth compared to the negative control (1% DMSO) ($P < 0.05$). The ethanolic, aqueous, and chloroform extracts exhibited inhibitory activities of 52.92%,32.90%, and 30.98%, respectively (Figure 2). The positive control, suramin (100 µM), showed the greatest inhibition (85.5%).

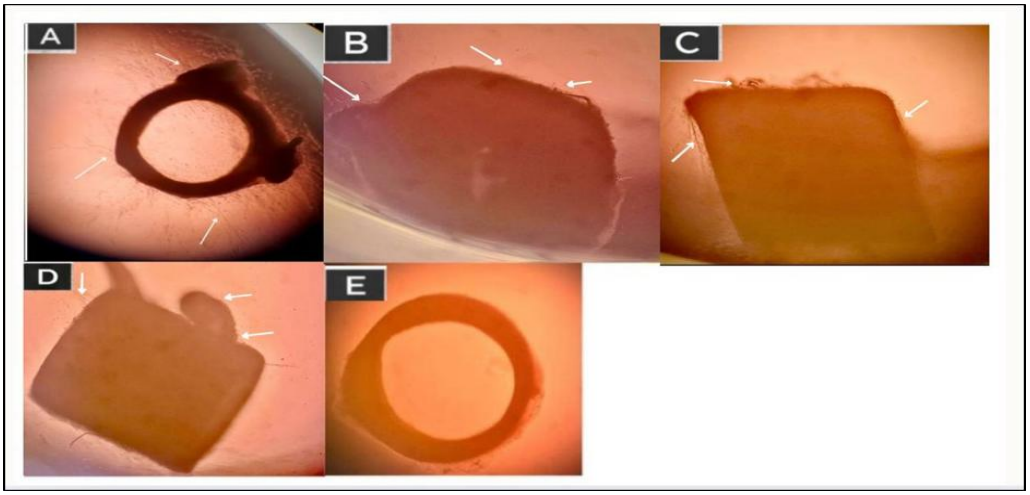

Figure 1: Representative microscopic images of rat aortic rings after 5 days incubation period.

(A) Negative control (1% DMSO), (B) chloroform extract, (C) ethanolic extract, (D) aqueous extract of Juglans regia L. green husk (100 µg/Ml), and € suramin (100 µM) as the positive control.

Table 2: Anti-angiogenic activity of *Juglans regia* L. green husk extracts using the rat aortic ring assay

Compound (Extract)	Concentration (µg/mL)	Microvessel growth (mm) Mean ± SD	Inhibition (%)
Chloroform extract	100	8.10 ± 2.38	30.98
Ethanolic extract	100	5.35 ±5.29	52.92
Aqueous extract	100	7.75 ± 4.94	32.90
Suramin (100µM) Positive control	—	1.70 ± 0.50	85.5

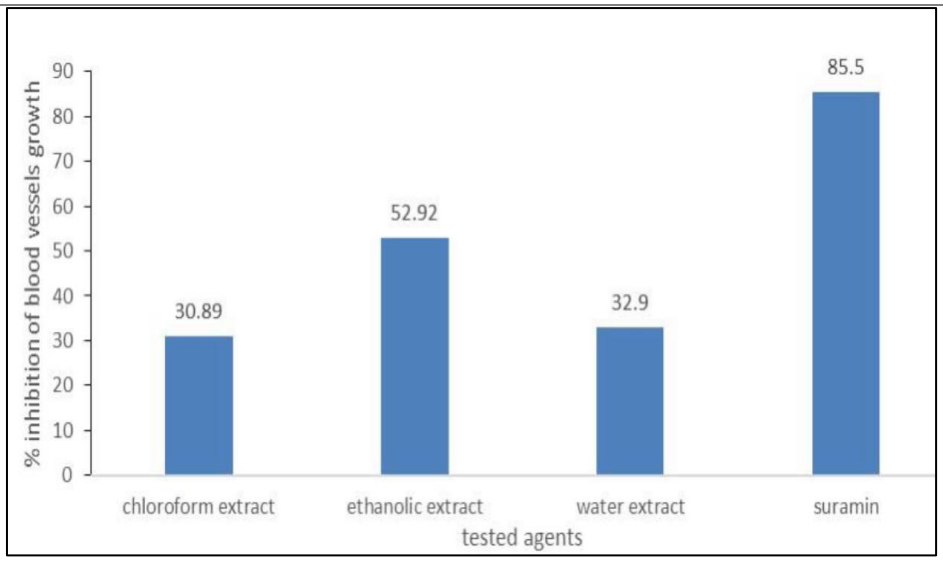

Figure 2: Percentage inhibition of microvessel growth induced by Juglans regia L. green husk extracts in the rat aortic ring assay. Data are expressed relative to negative control (1% DMSO). Suramin (100 µM) was used as a positive control.

Anti-angiogenic activity in the CAM Assay

The CAM assay (Figure 3) demonstrated significant anti-angiogenic activity of the ethanolic extract of *Juglans regia* L. The visual assessment showed that the treated group had a much lower vascular density than the negative control group. Quantitative vessel counting corroborated this finding, revealing a decrease in the mean vessel count from 16.83 ± 7.19 in the negative control group to 5.83 ± 1.72 in the treatment group (n = 6 per group, $P < 0.05$), signifying an angiogenesis inhibition of approximately 65.4% (Figure 4).

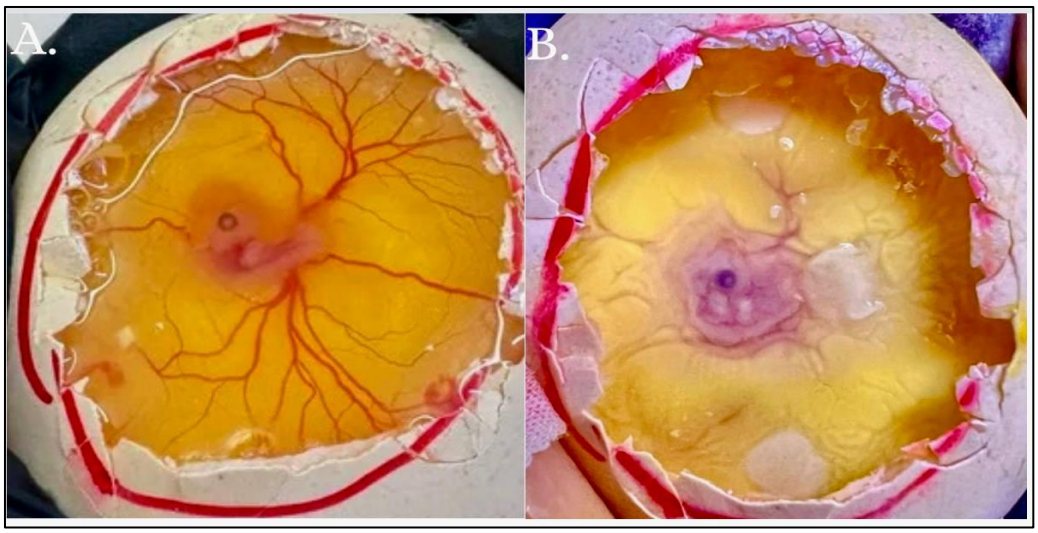

Figure 3: Representative CAM images of (A) negative control and (B) *Juglans regia* L. ethanolic extract-treated groups.

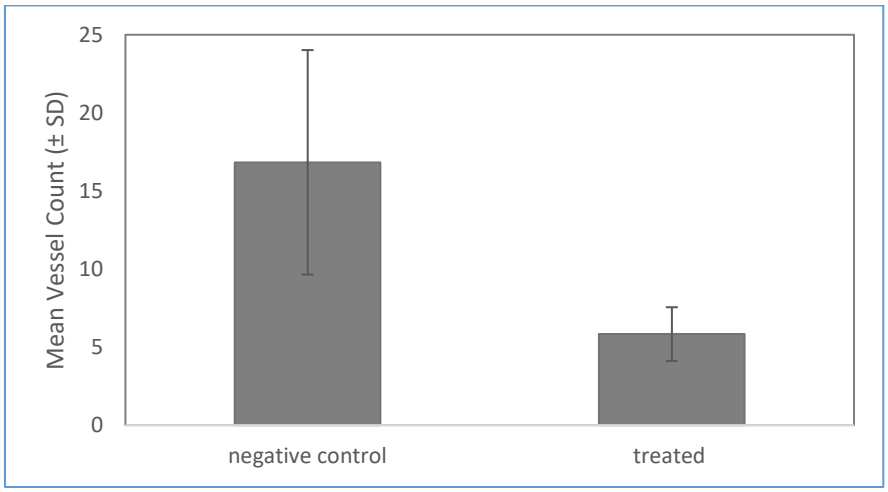

Figure 4: Effect of *Juglans regia* L. ethanolic extract on CAM vessel count. Data are presented as mean ± SD (n = 6). Anonymous.

Antioxidant Activity in DPPH Radical Scavenging Assay

The DPPH radical scavenging activity of the ethanolic extract was evaluated using the DPPH assay. The absorbance of the control (DPPH solution without extract) was determined experimentally by ELISA and recorded as 2.90 (absorbance), which was used for calculating the percentage of DPPH radical scavenging activity.

As shown in Table 3, the extract exhibited a concentration-dependent scavenging activity, with the highest activity observed at 100 µg/mL (83.7%), followed by a gradual decrease at lower

concentrations. Nonlinear regression analysis of the dose–response curve revealed an estimated IC_{50} value of approximately 23.3 µg/mL, as illustrated in Figure 4.

Table 3. Antioxidant activity of the ethanolic extract in the DPPH assay

Concentration (µg/mL)	Absorbance (Mean ± SD)	DPPH Scavenging (%)
100	0.49 ± 0.03	83.7 %
50	0.77 ± 0.02	74.3 %
25	1.30 ± 0.44	56.7 %
12.5	2.22 ± 0.11	26.0 %
6.25	2.63 ± 0.04	12.3 %
3.125	2.85 ± 0.07	5.0 %

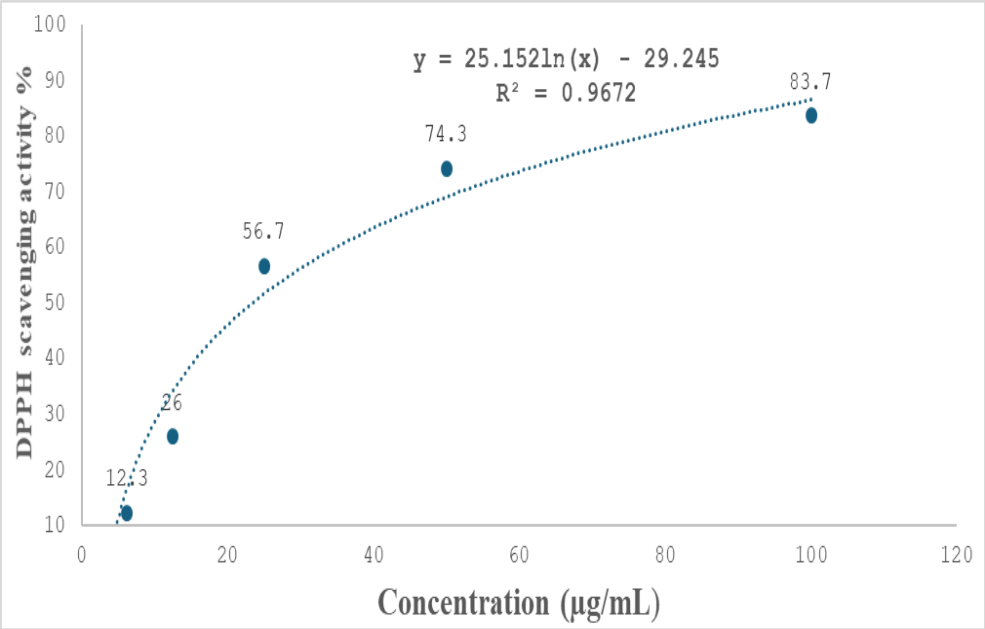

Figure 5. Dose–response curve of DPPH radical scavenging activity of the ethanolic extract of *Juglans regia* L. green husk.

DISCUSSION

Extraction Process

The sequential extraction of *Juglans regia* L. green husk using solvents of increasing polarity resulted in considerable variability in extraction yield. The aqueous extract had the highest yield (4.46%), followed by the ethanolic extract (2.15%), and the chloroform extract had the lowest yield (1.9%). The observed difference can be attributed to solvent polarity. Polar solvents are more efficient in extracting phenolic and other water-soluble phytochemicals. These results support previous studies that showed how important solvent polarity and extraction method are for phytochemical recovery and extraction efficiency [15].

Rat Aortic Ring Anti-Angiogenesis Assay

Angiogenesis assays are widely used to identify potential anti-angiogenic agents. The rat aortic ring model is a reliable *ex vivo* system that can be repeated and is strongly linked to angiogenesis in living organisms. The current study found that chloroform, ethanolic, and aqueous extracts of Juglans regia L. green husk significantly slowed the growth of microvessels compared to the negative control (1% DMSO) ($P < 0.05$). The ethanolic extract exhibited the highest inhibitory efficacy among the tested

extracts, presumably attributable to its increased concentrations of phenolic and flavonoid compounds, which are extensively recognized for their anti-angiogenic properties [16] .

Chick Chorioallantoic Membrane (CAM) Assay

The chick chorioallantoic membrane (CAM) assay is a well-established and highly vascularized in vivo model widely employed for the assessment of angiogenesis and the evaluation of anti-angiogenic pharmaceuticals. The CAM model is cost-effective, reproducible, and technically accessible *in vivo* model for evaluation angiogenesis [17].

The present study demonstrated that treatment with the ethanolic extract of Juglans regia L. green husk significantly reduced vascular density compared to the negative control. Both visual inspection and quantitative analysis confirmed significant inhibition of neovascularization ($P < 0.05$), indicating robust anti-angiogenic activity. The observed suppression of blood vessel formation may be attributed to bioactive phenolic and flavonoid compounds that modulate critical angiogenic signaling pathways [18]

Antioxidant Activity (DPPH Radical Scavenging Assay)

The DPPH radical scavenging assay was used to test how well the ethanolic extract of *Juglans regia* L. green husk worked as an antioxidant. The extract exhibited a pronounced concentration-dependent scavenging activity, indicating potent antioxidant potential.

The DPPH assay is widely employed to evaluate the hydrogen- or electron-donating ability of natural compounds through the reduction of the stable DPPH radical [19,20]

The notable scavenging activity observed in this study may be attributed to the presence of phenolic compounds, which are intrinsically associated with antioxidant capacity due to their capability to donate hydrogen atoms and stabilize free radicals [21].

The data show that the ethanolic extract has strong antioxidant properties, which may contribute to its overall biological efficacy.

CONCLUSION

The findings of this study indicate that *Juglans regia* L. green husk exhibits significant biological activity. Among the tested extracts, the ethanolic extract demonstrated the most pronounced anti-angiogenic and antioxidant effects. These activities may be attributed to their enriched phenolic content. Overall, the results suggest that the ethanolic extract represents a promising natural source of bioactive compounds with potential therapeutic applications. Further research should focus on bio-guided fractionation of the active metabolites and evaluate their safety profiles in higher mammalian models

ACKNOWLEDGMENT

The author would like to express their sincere gratitude to the College of Pharmacy and the College of Medicine at Al-Nahrain University for their continuous support and valuable assistance throughout this study. The facilities, resources, and scientific guidance provided by both colleges greatly contribute to the successful completion of this research.

CONFLICTS OF INTEREST

The author declares that they have no conflicts of interest.

FUNDING

No funding

ETHICS STATEMENTS

Ethical approval was obtained from The Ethics Committee of the College of Pharmacy, Al-Nahrain University (Approval No. SY/3/2/1012, dated 24 November 2020).

REFERENCES

1. Fodil, M.; Muñoz-Garcia, J.; Benali, A.-K.; Rogozarski, J.; Mignon, V.; Labrana, H.; Lokajczyk, A.; Pasetto, P.; Mouget, J.-L.; Boisson-Vidal, C.; et al. Effect of Precipitated Extracellular Marennine on Angiogenesis and Tumour Cell Proliferation. Mar. Drugs 2025, 23, 364. https://doi.org/10.3390/md23090364
2. Qiao, Y.; Yang, F.; Xie, T.; Du, Z.; Zhong, D.; Qi, Y.; Li, Y.; Li, W.; Lu, Z.; Rao, J.; et al. Engineered Algae: A Novel Oxygen-Generating System for Effective Treatment of Hypoxic Cancer. Sci. Adv. 2020, 6, eaba5996
3. Ciupei, D.; Coli¸sar, A.;Leopold, L.; Stănilă, A.; Diaconeasa, Z.M. Polyphenols: From Classification to Therapeutic Potential and Bioavailability. Foods 2024, 13, 4131. https://doi.org/10.3390/foods13244131
4. Méresse, S.; Gateau, H.; Tirnan, T.; Larrigaldie, V.; Casse, N.; Pasetto, P.; Mouget, J.-L.; Mortaud, S.; Fodil, M. Haslea Ostrearia Pigment Marennine Affects Key Actors of Neuroinflammation and Decreases Cell Migration in Murine Neuroglial Cell Model. Int. J. Mol. Sci. 2023, 24, 5388
5. Subbaraj GK, Kumar YS, Kulanthaivel L. Antiangiogenic role of natural flavonoids and their molecular mechanism: an update. The Egyptian Journal of Internal Medicine. 2021 Sep 6;33(1).
6. Adamovic, M.; Adamovic, A.; Andjic, M.; Dimitrijevic, J.;Zdravkovic, N.; Kostic, O.; Pecarski,D.; Pecarski, T.; Obradovic, D.;Tomovic, M. The Botany, Phytochemistry and the Effects of the Juglans regia on Healthy and Diseased Skin. Cosmetics 2024, 11, 163. https://doi.org/10.3390/cosmetics11050163
7. Lia G, Giaccone L, Leone S and Bruno B (2021) Biomarkers for Early Complications of Endothelial Origin After Allogeneic Hematopoietic Stem Cell Transplantation: Do They Have a Potential Clinical Role? Front. Immunol. 12:641427. doi: 10.3389/fimmu.2021.641427
8. Bhat, A.A.; Shakeel, A.;Rafiq, S.; Farooq, I.; Malik, A.Q.; Alghuthami, M.E.; Alharthi, S.; Qanash, H.; Alharthy, S.A. Juglans regia Linn.: A Natural Repository of Vital Phytochemical and Pharmacological Compounds. Life 2023, 13, 380. https://doi.org/10.3390/life13020380
9. Wenfeng Cao, Mingyue Wang, Wen Chai, Chaoqun Luo, Yanmei Wang, Xinhua Zhou, Jie Li and Lingjuan Li, Regulation of Angiogenesis in Cerebral Ischemic Rats through ceRNA Networks and Its Impact on Cerebral Ischemic Stroke Prognosis, Brain Research Bulletin, (2025) doi:https://doi.org/10.1016/j.brainresbull.2025.111703
10. Chen AXY, Yap KM, Kim JS, Sek K, Huang YK, Dunbar PA, Wiebking V, Armitage JD, Munoz I, Todd KL, Derrick EB, Nguyen D, Tong J, Chan CW, Hoang TX, Audsley KM, van Elsas MJ, Middelburg J, Lee JN, de Menezes MN, Cole TJ, Li J, Scheffler C, Scott AM, Mackay LK, Waithman J, Oliaro J, Harrison SJ, Parish IA, Lai J, Porteus MH, House IG, Darcy PK, Beavis PA. Rewiring endogenous genes in CAR T cells for tumour-restricted payload delivery. Nature. 2025 Aug;644(8075):241-251. doi: 10.1038/s41586-025-09212-7. Epub 2025 Jul 2. PMID: 40604285; PMCID: PMC12328239.
11. Souza RF, Caetano MAF, Magalhães HIR, Castelucci P. Study of tumor necrosis factor receptor in the inflammatory bowel disease. World J Gastroenterol. 2023 May 14;29(18):2733-2746. doi: 10.3748/wjg.v29.i18.2733. PMID: 37274062; PMCID: PMC10237104.
12. obczyńska-Rak, A.; Żylińska, B.; Nowicka, B.; Rak, E.; Rzepka, T. Role and Mechanisms of Angiogenesis in Tumours. Biology 2025, 14, 756. https://doi.org/10.3390/biology14070756
13. Obeagu EI. Platelet-derived growth factor (PDGF) and its impact in fibroid pathogenesis: A narrative review. Medicine (Baltimore). 2025 Jun 20;104(25):e42995. doi: 10.1097/MD.0000000000042995. PMID: 40550071; PMCID: PMC12187276.
14. Kim HJ, Kim G, Chi KY, Kim JH. In Vitro Generation of Luminal Vasculature in Liver Organoids: From Basic Vascular Biology to Vascularized Hepatic Organoids. Int J Stem Cells. 2023 Feb 28;16(1):1-15. doi: 10.15283/ijsc22154. Epub 2022 Oct 31. PMID: 36310029; PMCID: PMC9978835.
15. Phong HX, Viet NT, Quyen NTN, Van Thinh P, Trung NM, Ngan TTK. Phytochemical screening, total phenolic, flavonoid contents, and antioxidant activities of four spices commonly used in Vietnamese traditional medicine. Mater Today Proc [Internet]. 2022;56:A1–5. Available from: https://doi.org/10.1016/j.matpr.2021.12.142.
16. Payne S, Neal A, De Val S. Transcription factors regulating vasculogenesis and angiogenesis. Dev Dyn. 2024 Jan;253(1):28-58. doi: 10.1002/dvdy.575. Epub 2023 Mar 6. PMID: 36795082; PMCID: PMC10952167.
17. Shukla AK, Yoon S, Oh SO, Lee D, Ahn M, Kim BS. Advancement in Cancer Vasculogenesis Modeling through 3D Bioprinting Technology. Biomimetics (Basel). 2024 May 20;9(5):306. doi: 10.3390/biomimetics9050306. PMID: 38786516; PMCID: PMC11118135.

18. Cosma AA, Fenesan MP, Nesiu A, Melnic E, Ferician AM, Ferician OC, Ceban E, Sarb S, Cimpean AM. Exploring vasculogenesis in the normal human kidney and clear cell renal cell carcinoma: insights from development to tumor progression and biomarkers for therapy response. Front Oncol. 2024 Apr 30;14:1375190. doi: 10.3389/fonc.2024.1375190. PMID: 38746686; PMCID: PMC11091336.
19. J. Chen, S. Qin, Z. Xing, C. Peng, D. Li, Targeting angiogenesis in diabetic wound healing: New insight from chemical architecture to functional outcomes, Journal of Pharmaceutical Analysis, https://doi.org/10.1016/j.jpha.2025.101475.
20. Korablev AV, Sesorova IS, Sesorov VV, Vavilov PS, Mironov A, Zaitseva AV, Bedyaev EV, Mironov AA. New Interpretations for Sprouting, Intussusception, Ansiform, and Coalescent Types of Angiogenesis. Int J Mol Sci. 2024 Aug 6;25(16):8575. doi: 10.3390/ijms25168575. PMID: 39201261; PMCID: PMC11354496.
21. Arribas V, Onetti Y, Ramiro-Pareta M, Villacampa P, Beck H, Alberola M, Esteve-Codina A, Merkel A, Sperandio M, Martínez-Estrada OM, Schmid B, Montanez E. Endothelial TDP-43 controls sprouting angiogenesis and vascular barrier integrity, and its deletion triggers neuroinflammation. JCI Insight. 2024 Feb 1;9(5):e177819. doi: 10.1172/jci.insight.177819. PMID: 38300714; PMCID: PMC11143933.

تقييم التاثير المحتمل للجوز الأخضر في عمليه تجديد الاوعية الدموية والخلايا

عبير صابر [1]، حيدر بهاء صاحب[1]

[1]*فرع الادوية والسموم كلية الصيدلة، جامعة النهرين، بغداد، العراق.*

الخلاصة

الخلفية: يُعد تكوّن الأوعية الدموية عملية حيوية ترتبط بالعديد من الحالات المرضية، ومنها نمو الأورام وانتشارها. لذا يُعد البحث عن مصادر طبيعية قادرة على تثبيط هذه العملية مجالًا مهمًا في الدراسات الدوائية. هدفت هذه الدراسة إلى تقييم الفعالية المضادة لتكوّن الأوعية الدموية والنشاط المضاد للأكسدة لمستخلصات القشرة الخضراء لنبات الجوز.

الطرق: تم تحضير ثلاثة مستخلصات نباتية باستخدام الكلوروفورم والإيثانول والماء. جرى تقييم النشاط المضاد لتكوّن الأوعية الدموية باستعمال اختبار حلقة الأبهر الجرذي خارج الجسم الحي لتحديد المستخلص الأكثر فعالية، كما تم تأكيد النتائج باستخدام اختبار غشاء الجنين المشيمي في بيض الدجاج. إضافةً إلى ذلك، تم قياس النشاط المضاد للأكسدة باستخدام اختبار قياس قدرة معادلة الجذور الحرة، مع حساب قيمة نصف التركيز المثبط.

النتائج: أظهر المستخلص الإيثانولي تفوقًا واضحًا في تثبيط نمو الأوعية الدموية مقارنةً ببقية المستخلصات، حيث سُجل انخفاض معنوي في تكوّن الأوعية الدموية مقارنةً بمجموعة السيطرة. كما أكد اختبار غشاء الجنين المشيمي حدوث انخفاض ملحوظ في الكثافة الوعائية. إضافةً إلى ذلك، بيّن المستخلص الإيثانولي نشاطًا مضادًا للأكسدة يعتمد على التركيز، إذ ازدادت نسبة تثبيط الجذور الحرة بزيادة الجرعة.

الاستنتاج: تشير نتائج الدراسة إلى أن القشرة الخضراء لنبات الجوز تمتلك خصائص واعدة مضادة لتكوّن الأوعية الدموية ومضادة للأكسدة، مما يدعم إمكانية الاستفادة منها كمصدر طبيعي لمركبات ذات أهمية علاجية مستقبلية.

الكلمات المفتاحية: تكوين الأوعية، اختبار (CAM Optimization) (CAM) CAM، اختبار حلقة الأبهر في الفئران، البحث الجذري DPP