





















manuscript (FS, MS, EB), critical revision of the manuscript for important intellectual content (FS, MS), administrative, technical, or material support (FS, NG), and study supervision (FS, NG). All authors have made a significant contribution to this study and have approved the final manuscript.

**Acknowledgment:** We would like to express our gratitude to the Clinical Research Development Center of Kowsar Hospital and Mr. Mohammad Javad Nori for their assistance with this research project.

**Funding:** This study received no specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

## REFERENCES

- Almuhayawi M S: Propolis as a novel antibacterial agent. Saudi J Biol Sci 2020, 27(11): 3079–3086.  
DOI: <https://doi.org/10.1016/j.sjbs.2020.09.016>
- Martinotti S, Ranzato E: Propolis: A new frontier for wound healing?. Burns Trauma 2015, 3.  
DOI: <https://doi.org/10.1186/s41038-015-0010-z>
- Anjum S I, Ullah A, Khan K A, Attaullah M, Khan H, Ali H, Bashir M A, et al: Composition and functional properties of propolis (bee glue): A review. Saudi J Biol Sci 2019, 26(7): 1695–1703.  
DOI: <https://doi.org/10.1016/j.sjbs.2018.08.013>
- Thanoon I A-J, Khalaf D A: Effects of Bee Propolis on Blood Pressure. Ann Coll Med Mosul 2018, 40(1): 20–26.  
DOI: <https://doi.org/10.33899/mmed.2018.159191>
- Ismail D, Purwanto B, Wasita B, Supomo, Yasa K P, Soetrisno: Exploring the role of the combination of propolis and vitamin D3 on VCAM-1 and Caspase-3 expression in preventing atherosclerosis in chronic kidney disease rats. Bali Medical Journal 2022, 11(1): 160–165.  
DOI: <https://doi.org/10.15562/bmj.v11i1.3194>
- Wagh V D: Propolis: A wonder bees product and its pharmacological potentials. Adv Pharmacol Sci 2013, 2013: 308249. DOI: <https://doi.org/10.1155/2013/308249>
- Ma L, Wu Y, Li Y, Aazmi A, Zhou H, Zhang B, Yang H: Current Advances on 3D-Bioprinted Liver Tissue Models. Adv Healthc Mater 2020, 9(24): e2001517.

- DOI: <https://doi.org/10.1002/adhm.202001517>
- Massart J, Begriche K, Hartman J H, Fromenty B: Role of Mitochondrial Cytochrome P450 2E1 in Healthy and Diseased Liver. Cells 2022, 11(2): 288.  
DOI: <https://doi.org/10.3390/cells11020288>
- Singh U, Singh P, Singh P K, Shukla S, Singh R L, Mondal S: Evaluation of antioxidant potential, DNA damage and hepatoprotective properties of Lagenaria siceraria plant against acetaminophen induced hepatotoxicity. Functional Foods in Health and Disease 2023; 13(3): 117-134.  
DOI: <https://www.doi.org/10.31989/ffhd.v13i2.1072>
- Seydi E, Hosseini S A, Salimi A, Pourahmad J: Propolis induce cytotoxicity on cancerous hepatocytes isolated from rat model of hepatocellular carcinoma: Involvement of ROS-mediated mitochondrial targeting. PharmaNutrition 2016, 4(4): 143–150.  
DOI: <https://doi.org/10.1016/j.phanu.2016.10.001>
- Alves-Bezerra M, Cohen D E: Triglyceride metabolism in the liver. Compr Physiol 2018, 8(1): 1–8.  
DOI: <https://doi.org/10.1002/cphy.c170012>
- Antona M E, González P M, Ramos C, Cabrera J, Olano C, Morales C, Zago V. et al: Curcumin exerts a protective effect against obesity and liver injury induced by an atherogenic diet. Functional Foods in Health and Disease 2021; 11(12): 673-689.  
DOI: <https://www.doi.org/10.31989/ffhd.v11i12.862>
- Mon H, Ghadir M R, Riahin A A, Havaspour A, Nooranipour M, Habibinejad A A: The Relationship between Lipid Profile and Severity of Liver Damage in Cirrhotic Patients. Hepat Mon 2010, 10(4): 285–288.
- Valkov I, Ivanova R, Alexiev A, Antonov K, Mateva L: Association of serum lipids with hepatic steatosis, stage of liver fibrosis and viral load in chronic hepatitis C. J Clin Diagn Res 2017, 11(8): OC15–OC20.  
DOI: <https://doi.org/10.7860/JCDR/2017/28609.10459>
- Garcia-Cortes M, Robles-Diaz M, Stephens C, Ortega-Alonso A, Lucena M I, Andrade R J: Drug induced liver injury: an update. Arch Toxicol 2020, 94(10): 3381–3407.  
DOI: <https://doi.org/10.1007/s00204-020-02885-1>
- Bessone F, Hernandez N, Tagle M, Arrese M, Parana R, Mendez-Sánchez N, Ridruejo E, et al: Drug-induced liver injury: A management position paper from the Latin American Association for Study of the liver. Ann Hepatol 2021, 24: 100321.  
DOI: <https://doi.org/10.1016/j.aohp.2021.100321>

17. Clemens M M, McGill M R, Apte, U: Mechanisms and biomarkers of liver regeneration after drug-induced liver injury. *Advances in Pharmacology* 2019, 85: 241–262.  
DOI: <https://doi.org/10.1016/bs.apha.2019.03.001>
18. Tanaka M, Miyajima A: Liver regeneration and fibrosis after inflammation. *Inflamm Regen* 2016, 36(1): 19.  
DOI: <https://doi.org/10.1186/s41232-016-0025-2>
19. Aissat S, Ahmed M, Djebli N: Propolis-Sahara honeys preparation exhibits antibacterial and anti-biofilm activity against bacterial biofilms formed on urinary catheters. *Asian Pac J Trop Dis* 2016, 6(11): 873–877.  
DOI: [https://doi.org/10.1016/S2222-1808\(16\)61149-0](https://doi.org/10.1016/S2222-1808(16)61149-0)
20. Henshaw F R, Bolton T, Nube V, Hood A, Veldhoen D, Pfrunder L, McKew GL, et al: Topical application of the bee hive protectant propolis is well tolerated and improves human diabetic foot ulcer healing in a prospective feasibility study. *J Diabetes Complications* 2014, 28(6): 850–857.  
DOI: <https://doi.org/10.1016/j.jdiacomp.2014.07.012>
21. Zabaïou N, Fouache A, Trousson A, Baron S, Zellagui A, Lahouel M, Lobaccaro JA: Biological properties of propolis extracts: Something new from an ancient product. *Chem Phys Lipids* 2017, 207(Pt B): 214–222.  
DOI: <https://doi.org/10.1016/j.chemphyslip.2017.04.005>
22. Martirosyan D M, Stratton S: Advancing functional food regulation. *Bioactive Compounds in Health and Disease* 2023, 6(7): 166-171.  
DOI: <https://www.doi.org/10.31989/bchd.v6i7.1178>
23. Moreno M I N, Isla M I, Sampietro A R, Vattuone M A: Comparison of the free radical-scavenging activity of propolis from several regions of Argentina. *J Ethnopharmacol* 2000, 71(1–2): 109–114.  
DOI: [https://doi.org/10.1016/s0378-8741\(99\)00189-0](https://doi.org/10.1016/s0378-8741(99)00189-0)
24. Gheibi N, Edris M, Sofiabadi M, Samieirad F: Effect of silver nanoparticles orally consumption on blood biochemical factors in male rats. *Pejouhesh dar Pezeshki (Research in Medicine)* 2017, 40(4): 178–181.
25. Samiee-Rad F, Ghasemi F, Bahadoran E, Sofiabadi M, Shalhaf Z, Taherkhani A, Gheibi N: The effect of topical 0.5% humic acid gel on male rats with skin ulcer. *J Cutan Aesthet Surg* 2024, 17(2): 131-136.  
DOI: [https://doi.org/10.4103/jcas.jcas\\_104\\_23](https://doi.org/10.4103/jcas.jcas_104_23)
26. Hü S G: Histological grading and staging in chronic hepatitis: clinical applications and problems. *J Hepatol* 1998, 29(6): 1015–1022.  
DOI: [https://doi.org/10.1016/s0168-8278\(98\)80134-7](https://doi.org/10.1016/s0168-8278(98)80134-7)
27. Chuttong B, Lim K, Praphawilai P, Danmek K, Maitip J, Vit P, Wu M -C, et al: Exploring the Functional Properties of Propolis, Geopropolis, and Cerumen, with a Special Emphasis on Their Antimicrobial Effects. *Foods* 2023, 12(21): 3909. DOI: <https://doi.org/10.3390/foods12213909>
28. El Menyiy N, Al Waili N, Bakour M, Al-Waili H, Lyoussi B: Protective Effect of Propolis in Proteinuria, Crystaluria, Nephrotoxicity and Hepatotoxicity Induced by Ethylene Glycol Ingestion. *Arch Med Res* 2016, 47(7): 526–534.  
DOI: <https://doi.org/10.1016/j.arcmed.2016.12.010>
29. Mişe Yonar S, Ural M S, Silici S, Yonar M E: Malathion-induced changes in the haematological profile, the immune response, and the oxidative/antioxidant status of *Cyprinus carpio*: Protective role of propolis. *Ecotoxicol Environ Saf* 2014, 102: 202–209.  
DOI: <https://doi.org/10.1016/j.ecoenv.2014.01.007>
30. Pardo Andreu G L, Reis F H Z, Dalalio F M, Nuñez Figueredo Y, Cuesta Rubio O, Uyemura S A, Curti C, et al. The cytotoxic effects of brown Cuban propolis depend on the nemorosone content and may be mediated by mitochondrial uncoupling. *Chem Biol Interact* 2015, 228: 28–34. DOI: <https://doi.org/10.1016/j.cbi.2015.01.010>
31. Arain S Q, Talpur F N, Channa N A, Ali M S, Afridi H I: Serum lipid profile as a marker of liver impairment in hepatitis B Cirrhosis patients. *Lipids Health Dis* 2017, 17(1): 36.  
DOI: <https://doi.org/10.1186/s12944-017-0437-2>
32. Injue-Yun, Choi J, Choe H, Kim K, Go G, Lee D, Kim M: Anti-obesity effect of Microalga, *Melosira nummuloidea* ethanolic extract in high-fat-diet-induced obesity C57BL/6J mice. *Functional Foods in Health and Disease* 2022; 12(11): 693-704.  
DOI: <https://www.doi.org/10.31989/ffhd.v12i11.1002>
33. Nguyen P, Leray V, Diez M, Serisier S, Le Bloc'H J, Siliart B, Dumon H: Liver lipid metabolism. *J Anim Physiol Anim Nutr (Berl)* 2008, 92(3): 272–283.  
DOI: <https://doi.org/10.1111/j.1439-0396.2007.00752.x>
34. Bechmann L P, Hannivoort R A, Gerken G, Hotamisligil G S, Trauner M, Canbay A: The interaction of hepatic lipid and glucose metabolism in liver diseases. *J Hepatol* 2012, 56(4): 952–964. DOI: <https://doi.org/10.1016/j.jhep.2011.08.025>
35. Ipsen D H, Lykkesfeldt J, Tveden-Nyborg P: Molecular mechanisms of hepatic lipid accumulation in non-alcoholic fatty liver disease. *Cell Mol Life Sci* 2018, 75(18): 3313–3327. DOI: <https://doi.org/10.1007/s00018-018-2860-6>

36. Patel V, Sanyal A J: Drug-induced steatohepatitis. Clin Liver Dis 2013, 17(4): 533–546.  
DOI: <https://doi.org/10.1016/j.cld.2013.07.012>
37. Naramoto K, Kato M, Ichihara K: Effects of an ethanol extract of brazilian green propolis on human cytochrome P450 enzyme activities in Vitro. J Agric Food Chem 2014, 62(46): 11296–11302.  
DOI: <https://doi.org/10.1021/jf504034u>
38. Brewer C T, Chen T: Hepatotoxicity of herbal supplements mediated by modulation of cytochrome P450. Int J Mol Sci 2017, 18(11): 2353.  
DOI: <https://doi.org/10.3390/ijms18112353>
39. Ryu C S, Oh S J, Oh J M, Lee J Y, Lee S Y, Chae J W, Kwon K I, et al: Inhibition of cytochrome P450 by propolis in human liver microsomes. Toxicol Res 2016, 32(3): 207–213.  
DOI: <https://doi.org/10.5487/TR.2016.32.3.207>
40. Miguel M G, Antunes M D: Is propolis safe as an alternative medicine. J Pharm Bioallied Sci 2011, 3(4): 479–495.  
DOI: <https://doi.org/10.4103/0975-7406.90101>
41. Herrera Y, Diaz Garcia A, Sánchez H, Ruiz-Fuentes J, Monzote L, Setzer W: Cytotoxic effect of Cuban propolis extracts on normal cells and in-vitro basal toxicity assay to estimate acute oral toxicity. American Journal of Essential Oils and Natural Products 2014, 2(1): 19–23.
42. Viuda-Martos M, Pérez-Alvarez J A, Fernández-López J: Royal jelly: Health benefits and uses in medicine. Bee Products - Chemical and Biological Properties 2017: 199–218. DOI: [https://doi.org/10.1007/978-3-319-59689-1\\_10](https://doi.org/10.1007/978-3-319-59689-1_10)
43. Oršolić N, Jurčević I L, Đikić D, Rogić D, Odeh D, Balta V, Perak Junaković E, et al: Effect of Propolis on Diet-induced hyperlipidemia and atherogenic indices in mice. Antioxidants 2019, 8(6), 156.  
DOI: <https://doi.org/10.3390/antiox8060156>
44. El-Mahalaway A M, Selim A A, Mahboub F A R: The potential protective effect of propolis on experimentally induced hepatitis in adult male albino rats. Histological and immunohistochemical study. J Histol Histopathol 2015, 2(1):14. DOI: <https://doi.org/10.7243/2055-091x-2-14>
45. Fromenty B: Inhibition of mitochondrial fatty acid oxidation in drug-induced hepatic steatosis. Liver Res 2019, 3(3–4): 157–169. DOI: <https://doi.org/10.1016/j.livres.2019.06.001>