OPTIMIZATION OF PROPOLIS ULTRASOUND-ASSISTED EXTRACT AND IDENTIFICATION OF ITS PHYTOCHEMICAL AND WOUND HEALING PROPERTIES

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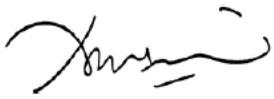
We hereby declare that We have checked this thesis, and, in our opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Doctor of Philosophy.



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ABSTRAK

Produk semula jadi seperti propolis telah menarik perhatian para penyelidik kerana kewujudan pelbagai sebatian aktif yang bermanfaat seperti fenolik dan flavonoid dan sebatian ini mempunyai sifat anti-radang, anti-oksidatif, anti-mikrob, anti-karsinogenik, penyembuhan luka dan lain-lain lagi. Walau bagaimanapun, untuk mendapatkan sebatian fenolik dan fitokimia aktif dari propolis, propolis mentah perlu menjalani proses pengekstrakan terlebih dahulu. Secara amnya, kaedah pengekstrakan konvensional (pemerahan) (MAE) merupakan kaedah pengekstrakan yang paling biasa digunakan untuk mengekstrak sebatian aktif daripada propolis tetapi malangnya, kaedah tersebut memerlukan masa dan tenaga yang banyak serta melibatkan penggunaan pelarut yang tinggi. Informasi tentang kesan sitotoksisiti dari penggunaannya dan potensi kesan penyembuhan luka masih kurang. Kajian ini direkabentuk untuk membandingkan kecekapan pemerahan (MAE) dengan kaedah pengekstrakan bukan konvensional (pengestrakan berbantu ultrasonik) (UAE) melalui kajian kinetik dan termodinamik dan untuk menyiasat penggunaan Metodologi Permukaan Tindak Balas (RSM) kepada pengestrakan berbantu ultrasonik terhadap pengekstrakan jumlah kandungan fenolik (TPC) dari propolis lebah tanpa sengat *Geniotrigona thoracica* dari Malaysia serta keupayaan penyembuhan luka. Analisis jumlah kandungan fenolik dan jumlah flavonoid, ujian penghapusan radikal bebas α, α-diphenyl-β-picrylhydrazyl (DPPH) dan 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid ($ABTS^+$) dan ujian *Ferric Reducing Ability of Plasma* (FRAP) telah dilaksanakan untuk menentukan aktiviti pengantioksidaan ekstrak propolis. Analisis (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl-2H-tetrazolium bromide) MTT dan ujian calar telah dilakukan pada sel EA.hy926 untuk mengkaji kesan sitotoksisiti dan potensi aktiviti penyembuhan luka oleh ekstrak propolis. Keputusan kinetik dan termodinamik pengekstrakan berbantu ultrasonik ialah; Ea; 0.032kJ/mol, ΔH#: -2.7796 hingga -2.4470 kJ/mol, ΔS#: ~8.22 J/kmol dan ΔG#: -5559.16 hingga -4894.01 J, manakala, pemerahan Ea: 68.13 #: 65.3160 hingga 65.6486 kJ/mol, ΔS#: -220.19 hingga -193.16 J/kmol dan ΔG#: 130633.08 hingga 131298.25 J. Pengoptimuman menghasilkan TPC (berkod), $Y = 0.082 + 0.013X_1 + 0.006114X_2 + 0.007554X_3 – 0.001739X_1X_2 – 0.00725X_1X_3 – 0.0006892X_2X_3 + 0.006103X_1^2 – 0.00148X_2^2 – 0.003858X_3^2$ dan keadaan optimum untuk kepekatan etanol (X_1) adalah 80%, masa pengestrakan (X_2) adalah 25 minit dan suhu pengestrakan (X_3) adalah 60°C yang menghasilkan 0.1007 ± 0.272 mg GAE/ g (eksperimen) dan 0.1041 mg GAE/g (diramalkan). TPC tertinggi didapati dari 80% ekstrak etanolik propolis; TPC: 8.8975 ± 0.008 mg GAE/g, dan TFC tertinggi didapati dari 50% ekstrak, iaitu 0.0276 ± 0.0335 mg QE/g. Bagi aktiviti penghapusan radikal bebas DPPH dan $ABTS^+$, nilai IC_{50} masing-masing ialah 0.0584 mg TE/ml dan 0.3979 mg TE/ml. 20% ekstrak propolis adalah tidak toksik kepada sel EA.hy926 manakala 50% dan 80% ekstrak adalah toksik dengan IC_{50} sebanyak 97.5 µg/ml dan 58 µg/ml secara individu. Dalam ujian calar, sel yang dirawat dengan 20% ekstrak propolis membentuk lapisan tunggal selepas inkubasi 18 jam manakala, luka yang tidak dirawat (kawalan negatif) tertutup sepenuhnya selepas 24 jam. Kajian ini menunujukkan UAE lebih efisien dan lebih menjimatkan berbanding MAE dalam pengekstrakan TPC daripada propolis, terdapat kesan sinergistik antara kepekatan etanol, masa pengekstrakan dan suhu pengekstrakan yang menghasilkan TPC tertinggi, propolis mempamerkan aktiviti pengantioksidaan, sitotoksisiti dan keupayaan penyembuhan luka pada kepekatan tertentu terhadap sel EA.hy926.

ABSTRACT

Natural products like propolis have captivated endless attention among researchers due to the presence of various beneficially active compounds such as phenolic acids and flavonoids and these compounds possess anti- inflammatory, anti- oxidative, anti-microbial, anti- carcinogenic, wound healing properties and many others. However, to obtain the phenolic compounds and active phytochemicals from propolis, the crude propolis is required to undergo an extraction process first. Generally, conventional extraction method (maceration) (MAE) has been the most commonly used extraction method to extract active compounds from propolis but unfortunately, the method requires ample time and energy as well as involving high amount of solvent usage. The information on the cytotoxicity effect of the usage and its potential wound healing effect is still lacking. This study was designed to compare the efficiency of maceration (MAE) with the non- conventional extraction method (ultrasonic- assisted extraction) (UAE) through kinetic and thermodynamic studies and to investigate the use Response Surface Methodology (RSM) to ultrasonic- assisted extraction on the extraction of total phenolic content (TPC) from Malaysian propolis from *Geniotrigona thoracica* stingless bees as well as its potential wound healing capability. Total phenolic and total flavonoid content analyses, α, α-diphenyl-β-picrylhydrazyl (DPPH), 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid ($ABTS^+$) free radical scavenging assays and Ferric Reducing Ability of Plasma (FRAP) assay were implemented to determine the antioxidant activity of propolis extracts. 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl-2H-tetrazolium bromide (MTT) analysis and scratch assays were done on EA.hy926 cells to study the cytotoxicity effect and potential wound healing activity of propolis extracts. The kinetics and thermodynamics results of ultrasonic-assisted extraction were; E_a; 0.032kJ/mol, $\Delta H^{\#}$: -2.7796 to -2.4470 kJ/mol, $\Delta S^{\#}$: ~8.22 J/kmol and $\Delta G^{\#}$: -5559.16 to -4894.01 J, whereas, maceration's E_a: 68.13 kJ/mol, $\Delta H^{\#}$: 65.3160 to 65.6486 kJ/mol, $\Delta S^{\#}$: -220.19 to -193.16 J/kmol and $\Delta G^{\#}$: 130633.08 to 131298.25 J. The optimization resulted in TPC (coded), $Y = 0.082 + 0.013X_1 + 0.006114X_2 + 0.007554X_3 - 0.001739X_1X_2 - 0.00725X_1X_3 - 0.0006892X_2X_3 + 0.006103X_1^2 - 0.001487X_2^2 - 0.003858X_3^2$and the optimum conditions for ethanol concentration (X_1) was 80%, extraction time (X_2) was 25 minutes and extraction temperature (X_3) was 60ºC which yielded 0.1007 ± 0.272 mg GAE/ g (experimental) and 0.1041 mg GAE/g (predicted) of TPC. The highest TPC was found from 80% ethanolic propolis extract; TPC: 8.8975 ± 0.008 mg GAE/g, and the highest TFC was found from 50% extract, which was 0.0276 ± 0.0335 mg QE/g. For the free radical scavenging activity of DPPH and $ABTS^+$, the IC_{50} values were 0.0584 mg TE/ml and 0.3979 mg TE/ml, respectively. 20% ethanolic propolis extract was non-toxic to cells while 50% and 80% extracts were toxic with IC_{50} of 97.5 µg/ml and 58 µg/ml individually. In scratch assay, the EA.hy926 cells were treated with 20% of ethanolic propolis extracts and formed monolayers after 18 hours of incubation, whereas, the untreated wound (negative control) was completely closed after 24 hours. This study revealed that UAE was more efficient and economical than MAE in the TPC extraction from propolis, there was a synergistic effect of ethanol concentration, extraction time and extraction temperature has generated the highest TPC, propolis exhibited antioxidant activity, cytotoxicity and potential wound healing capability at a certain concentration on EA.hy926cells.

TABLE OF CONTENT

REFERENCES

Abd Aziz, N. A., Hasham, R., Sarmidi, M. R., Suhaimi, S. H., & Idris, M. K. H. (2021). A review on extraction techniques and therapeutic value of polar bioactives from Asian medicinal herbs: Case study on Orthosiphon aristatus, Eurycoma longifolia and Andrographis paniculata. *Saudi Pharmaceutical Journal*, *29*(2), 143–165. https://doi.org/10.1016/j.jsps.2020.12.016

Abd Jalil, M. A., Kasmuri, A. R., & Hadi, H. (2017). Stingless bee honey, the natural wound healer: A review. *Skin Pharmacology and Physiology*, *30*(2), 66–75. https://doi.org/10.1159/000458416

Abdullah, H., Ibrahim, M., Ahmed, I. A., Ramli, N., Jalil, A. M. M., & Fatihah, A. R. N. (2021). Optimisation of phenolic compounds and antioxidant capacity of Trigona honey and propolis using response surface methodology from fermented food products. *International Food Research Journal*, *28*(6), 1233–1244. https://doi.org/10.47836/ifrj.28.6.15

Abdullah, N. A., Ja'afar, F., Yasin, H. M., Taha, H., Petalcorin, M. I. R., Mamit, M. H., Kusrini, E., & Usman, A. (2019). Physicochemical analyses, antioxidant, antibacterial, and toxicity of propolis particles produced by stingless bee Heterotrigona itama found in Brunei Darussalam. *Heliyon*, *5*(9), e02476. https://doi.org/10.1016/j.heliyon.2019.e02476

Aboulghazi, A., Bakour, M., Fadil, M., & Lyoussi, B. (2022). Simultaneous Optimization of Extraction Yield, Phenolic Compounds and Antioxidant Activity of Moroccan Propolis Extracts: Improvement of Ultrasound-Assisted Technique Using Response Surface Methodology. *Processes*, *10*(2). https://doi.org/10.3390/pr10020297

Abu-Seida, A. M. (2015). Effect of propolis on experimental cutaneous wound healing in dogs. *Veterinary Medicine International*, *2015*. https://doi.org/10.1155/2015/672643

Abutaha, N. (2020). Apoptotic potential and chemical composition of jordanian propolis extract against different cancer cell lines. *Journal of Microbiology and Biotechnology*, *30*(6), 893–902. https://doi.org/10.4014/jmb.1905.05027

Afonso, A. M., Gonçalves, J., Luís, Â., Gallardo, E., & Duarte, A. P. (2020). Evaluation of the in vitro wound-healing activity and phytochemical characterization of propolis and honey. *Applied Sciences (Switzerland)*, *10*(5), 6–8. https://doi.org/10.3390/app10051845

Agu, C. M., Menkiti, M. C., Ohale, P. E., & Ugonabo, V. I. (2021). Extraction modeling, kinetics, and thermodynamics of solvent extraction of Irvingia gabonensis kernel oil, for possible industrial application . *Engineering Reports*, *3*(4), 1–25. https://doi.org/10.1002/eng2.12306

Ahmed, F., & Iqbal, M. (2018). Antioxidant activity of Ricinus Communis. *Organic & Medicinal Chemistry International Journal*, *5*(4), 3–8. https://doi.org/10.19080/omcij.2018.05.555667

Ahn, M. R., Kumazawa, S., Usui, Y., Nakamura, J., Matsuka, M., Zhu, F., & Nakayama, T. (2007). Antioxidant activity and constituents of propolis collected in various areas of China. *Food Chemistry*, *101*(4), 1383–1392. https://doi.org/10.1016/j.foodchem.2006.03.045

Al-Ghamdi, A. A., Bayaqoob, N. I. M., Rushdi, A. I., Alattal, Y., Simoneit, B. R. T., El-Mubarak, A. H., & Al-Mutlaq, K. F. (2017). Chemical compositions and characteristics of organic compounds in propolis from Yemen. *Saudi Journal of Biological Sciences*, *24*(5), 1094–1103. https://doi.org/10.1016/j.sjbs.2016.12.012

Al-Hatamleh, M. A. I., Boer, J. C., Wilson, K. L., Plebanski, M., Mohamud, R., & Mustafa, M. Z. (2020). Antioxidant-based medicinal properties of stingless bee products: Recent progress and future directions. *Biomolecules*, *10*(6), 1–28. https://doi.org/10.3390/biom10060923

Al-Salahi, O. S. A., Kit-Lam, C., Majid, A. M. S. A., Al-Suede, F. S. R., Mohammed Saghir, S. A., Abdullah, W. Z., Ahamed, M. B. K., & Yusoff, N. M. (2013). Anti-angiogenic quassinoid-rich fraction from Eurycoma longifolia modulates endothelial cell function. *Microvascular Research*, *90*, 30–39. https://doi.org/10.1016/j.mvr.2013.07.007

Al-Suede, F. S. R., Khadeer Ahamed, M. B., Abdul Majid, A. S., Saghir, S. A. M., Oon, C. E., & Majid, A. M. S. A. (2021). Immunomodulatory and antiangiogenic mechanisms of polymolecular botanical drug extract C5OSEW5050ESA OS derived from orthosiphon stamineus. *Journal of Angiotherapy*, *5*(1), E194–E206. https://doi.org/10.25163/angiotherapy.51211411913130321

Al Jitan, S., Alkhoori, S. A., & Yousef, L. F. (2018). Phenolic Acids From Plants: Extraction and Application to Human Health. In *Studies in Natural Products Chemistry* (1st ed., Vol. 58). Elsevier B.V. https://doi.org/10.1016/B978-0-444-64056-7.00013-1

Al Naggar, Y., Sun, J., Robertson, A., Giesy, J. P., & Wiseman, S. (2016). Caracterización química y propiedades antioxidantes del propóleos canadiense. *Journal of Apicultural Research*, *55*(4), 305–314. https://doi.org/10.1080/00218839.2016.1233700

Alara, O. R., Abdurahman, N. H., Ali, H. A., & Zain, N. M. (2021). Microwave-assisted extraction of phenolic compounds from Carica papaya leaves: An optimization study and LC-QTOF-MS analysis. *Future Foods*, *3*(April), 100035. https://doi.org/10.1016/j.fufo.2021.100035

Alara, O. R., Abdurahman, N. H., & Olalere, O. A. (2018). Ethanolic extraction of bioactive compounds from Vernonia amygdalina leaf using response surface methodology as an optimization tool. *Journal of Food Measurement and Characterization*, *12*(2), 1107–1122. https://doi.org/10.1007/s11694-018-9726-3

Alberti, T., Coelho, D., Voytena, A., Iacovski, R., Mazzarino, L., & Maraschin, M. (2019). *Effect of Propolis Nanoparticles on Early-Stage Wound Healing in a Diabetic Noncontractile Wound Model*. *2*(1), 1–10.

Alvarado-Sansininea, J. J., Sánchez-Sánchez, L., López-Muñoz, H., Escobar, M. L., Flores-Guzmán, F., Tavera-Hernández, R., & Jiménez-Estrada, M. (2018). Quercetagetin and patuletin: Antiproliferative, necrotic and apoptotic activity in tumor cell lines. *Molecules*, *23*(10). https://doi.org/10.3390/molecules23102579

Ambi, A., Bryan, J., Borbon, K., Centeno, D., Liu, T., Chen, T. P., Cattabiani, T., & Traba, C. (2017). Are Russian propolis ethanol extracts the future for the prevention of medical and biomedical implant contaminations? *Phytomedicine*, *30*, 50–58. https://doi.org/10.1016/j.phymed.2017.03.006

Amin, Z. A., Ali, H. M., Alshawsh, M. A., Darvish, P. H., & Abdulla, M. A. (2015). Application of Antrodia camphorata Promotes Rat's Wound Healing in Vivo and Facilitates Fibroblast Cell Proliferation in Vitro. *Evidence-Based Complementary and Alternative Medicine*, *2015*. https://doi.org/10.1155/2015/317693

Andrade, J. K. S., Denadai, M., de Oliveira, C. S., Nunes, M. L., & Narain, N. (2017a). Evaluation of bioactive compounds potential and antioxidant activity of brown, green and red propolis from Brazilian northeast region. *Food Research International*, *101*(August), 129–138. https://doi.org/10.1016/j.foodres.2017.08.066

Andrade, J. K. S., Denadai, M., de Oliveira, C. S., Nunes, M. L., & Narain, N. (2017b). Evaluation of bioactive compounds potential and antioxidant activity of brown, green and red propolis from Brazilian northeast region. *Food Research International*, *101*(August), 129–138. https://doi.org/10.1016/j.foodres.2017.08.066

Andrade, T. A., Hamerski, F., López Fetzer, D. E., Roda-Serrat, M. C., Corazza, M. L., Norddahl, B., & Errico, M. (2021). Ultrasound-assisted pressurized liquid extraction of anthocyanins from Aronia melanocarpa pomace. *Separation and Purification Technology*, *276*(July). https://doi.org/10.1016/j.seppur.2021.119290

Anjum, S. I., Ullah, A., Khan, K. A., Attaullah, M., Khan, H., Ali, H., Bashir, M. A., Tahir, M., Ansari, M. J., Ghramh, H. A., Adgaba, N., & Dash, C. K. (2018). Composition and functional properties of propolis (bee glue): A review. *Saudi Journal of Biological Sciences*. https://doi.org/10.1016/j.sjbs.2018.08.013

Antimicrobial, P. (2016). *GC-MS Analysis and Preliminary Antimicrobial Activity of Albizia adianthifolia (Schumach) and Pterocarpus angolensis (DC)*. *Dc*. https://doi.org/10.3390/medicines3010003

Antony, A., & Farid, M. (2022). Effect of Temperatures on Polyphenols during Extraction. *Applied Sciences (Switzerland)*, *12*(4). https://doi.org/10.3390/app12042107

Araújo, K. S. da S., dos Santos Júnior, J. F., Sato, M. O., Finco, F. D. B. A., Soares, I. M., Barbosa, R. dos S., Alvim, T. D. C., Ascêncio, S. D., & Mariano, S. M. B. (2016). Physicochemical properties and antioxidant capacity of propolis of stingless bees (Meliponinae) and apis from two regions of Tocantins, Brazil. *Acta Amazonica*, *46*(1), 61–68. https://doi.org/10.1590/1809-4392201501045

Arora, S., & Kumar, G. (2018). *Phytochemical screening of root , stem and leaves of Cenchrus biflorus Roxb*. *7*(1), 1445–1450.

Aru, B., Güzelmeric, E., Akgül, A., Demirel, G. Y., & Kırmızıbekmez, H. (2019). Antiproliferative Activity of Chemically Characterized Propolis from Turkey and Its Mechanisms of Action. *Chemistry and Biodiversity*, *16*(7). https://doi.org/10.1002/cbdv.201900189

Aryal, S., Baniya, M. K., Danekhu, K., Kunwar, P., Gurung, R., & Koirala, N. (2019). Total Phenolic content, Flavonoid content and antioxidant potential of wild vegetables from western Nepal. *Plants*, *8*(4). https://doi.org/10.3390/plants8040096

Asadzadeh, F., Maleki-Kaklar, M., Soiltanalinejad, N., & Shabani, F. (2018). Central composite design optimization of zinc removal from contaminated soil, using citric acid as biodegradable chelant. *Scientific Reports*, *8*(1), 1–8. https://doi.org/10.1038/s41598-018-20942-9

Ascione, F., Vasaturo, A., Caserta, S., D'Esposito, V., Formisano, P., & Guido, S. (2016). Comparison between fibroblast wound healing and cell random migration assays in vitro. *Experimental Cell Research*, *347*(1), 123–132. https://doi.org/10.1016/j.yexcr.2016.07.015

Asgharpour, F., Moghadamnia, A. A., Zabihi, E., Kazemi, S., Ebrahimzadeh Namvar, A., Gholinia, H., Motallebnejad, M., & Nouri, H. R. (2019). Iranian propolis efficiently inhibits growth of oral streptococci and cancer cell lines. *BMC Complementary and Alternative Medicine*, *19*(1), 1–8. https://doi.org/10.1186/s12906-019-2677-3

Aziz, M. A., Diab, A. S., & Mohammed, A. A. (n.d.). *Antioxidant Categories and Mode of Action*.

Azmi, W. A., Zulqurnain, N. S., & Ghazi, R. (2015). Melissopalynology and foraging activity of stingless bees, Lepidotrigona Terminata (Hymenoptera: Apidae) from an apiary in Besut, Terengganu. *Journal of Sustainability Science and Management*, *10*(1), 27–35.

Baharetha, H. M., Nassar, Z. D., Aisha, A. F., Ahamed, M. B. K., Al-Suede, F. S. R., Kadir, M. O. A., Ismail, Z., & Majid, A. M. S. A. (2013). Proapoptotic and antimetastatic properties of supercritical CO2 extract of Nigella sativa Linn. Against breast cancer cells. *Journal of Medicinal Food*, *16*(12), 1121–1130. https://doi.org/10.1089/jmf.2012.2624

Bakdash, A., Almohammadi, O. H., Taha, N. A., Abu-Rumman, A., & Kumar, S. (2018). Chemical composition of propolis from the baha region in Saudi Arabia. *Czech*

Journal of Food Sciences, *36*(2), 109–118. https://doi.org/10.17221/119/2017-CJFS

Bakkaloglu, Z., Arici, M., & Karasu, S. (2021). Optimization of ultrasound-assisted extraction of turkish propolis and characterization of phenolic profile, antioxidant and antimicrobial activity. *Food Science and Technology (Brazil)*, *41*(3), 687–695. https://doi.org/10.1590/fst.14520

Bankova, V. S., De Castro, S. L., & Marcucci, M. C. (2000). Propolis: Recent advances in chemistry and plant origin. *Apidologie*, *31*(1), 3–15. https://doi.org/10.1051/apido:2000102

Banskota, A. H., Nagaoka, T., Sumioka, L. Y., Tezuka, Y., Awale, S., Midorikawa, K., Matsushige, K., & Kadota, S. (2002). *Antiproliferati v e acti v ity of the Netherlands propolis and its acti v e principles in cancer cell lines*. *80*, 67–73.

Barbarić, M., Mišković, K., Bojić, M., Lončar, M. B., Smolčić-Bubalo, A., Debeljak, Ž., & Medić-Šarić, M. (2011). Chemical composition of the ethanolic propolis extracts and its effect on HeLa cells. *Journal of Ethnopharmacology*, *135*(3), 772–778. https://doi.org/10.1016/j.jep.2011.04.015

Barks, S. (2019). *Mohamed Zaky Zayed,*. *14*, 996–1013.

Bayram, N. E., Gerçek, Y. C., & Öz, G. C. (2020). Screening for antioxidant capacity, pollen types and phytochemical profile by GC/MS and UHPLC from propolis. *Progress in Nutrition*, *22*(3). https://doi.org/10.23751/pn.v22i3.8416

Belfar, M. L., Lanez, T., Rebiai, A., & Ghiaba, Z. (2015a). Evaluation of antioxidant capacity of propolis collected in various areas of Algeria using electrochemical techniques. *International Journal of Electrochemical Science*, *10*(11), 9641–9651.

Belfar, M. L., Lanez, T., Rebiai, A., & Ghiaba, Z. (2015b). *Evaluation of Antioxidant Capacity of Propolis Collected in Various Areas of Algeria Using Electrochemical Techniques*. *10*, 9641–9651.

Beulah, G. G., Soris, P. T., & Mohan, V. R. (2018). *GC-MS Determination of Bioactive Compounds of Dendrophthoe falcata (L . F) Ettingsh : An Epiphytic Plant*. *8*(November), 261–269.

Biedermann, D., Moravcová, V., Valentová, K., Kuzma, M., Petrásková, L., Císařová, I., & Křen, V. (2019). Oxidation of flavonolignan silydianin to unexpected lactone-acid derivative. *Phytochemistry Letters*, *30*(December 2018), 14–20. https://doi.org/10.1016/j.phytol.2019.01.006

Biscaia, D., & Ferreira, S. R. S. (2009). Propolis extracts obtained by low pressure methods and supercritical fluid extraction. *Journal of Supercritical Fluids*, *51*(1), 17–23. https://doi.org/10.1016/j.supflu.2009.07.011

Blainski, A., Lopes, G. C., & De Mello, J. C. P. (2013). Application and analysis of the folin ciocalteu method for the determination of the total phenolic content from

limonium brasiliense L. *Molecules*, *18*(6), 6852–6865. https://doi.org/10.3390/molecules18066852

Bolanos De La Torre, A. A. S., Henderson, T., Nigam, P. S., & Owusu-Apenten, R. K. (2015). A universally calibrated microplate ferric reducing antioxidant power (FRAP) assay for foods and applications to Manuka honey. *Food Chemistry*, *174*, 119–123. https://doi.org/10.1016/j.foodchem.2014.11.009

Bonamigo, T., Campos, J. F., Alfredo, T. M., Balestieri, J. B. P., Cardoso, C. A. L., Paredes-Gamero, E. J., De Picoli Souza, K., & Dos Santos, E. L. (2017). Antioxidant, Cytotoxic, and Toxic Activities of Propolis from Two Native Bees in Brazil: Scaptotrigona depilis and Melipona quadrifasciata anthidioides. *Oxidative Medicine and Cellular Longevity*, *2017*. https://doi.org/10.1155/2017/1038153

Bonfigli, M., Godoy, E., Reinheimer, M. A., & Scenna, N. J. (2017). Comparison between conventional and ultrasound-assisted techniques for extraction of anthocyanins from grape pomace. Experimental results and mathematical modeling. *Journal of Food Engineering*, *207*, 56–72. https://doi.org/10.1016/j.jfoodeng.2017.03.011

Br, R. (2021). *Phytochemical analysis of bioactive compounds in ethanolic extract of Sterculia*. *030098*(May).

Busch, V. M., Pereyra-Gonzalez, A., Šegatin, N., Santagapita, P. R., Poklar Ulrih, N., & Buera, M. P. (2017). Propolis encapsulation by spray drying: Characterization and stability. *LWT - Food Science and Technology*, *75*, 227–235. https://doi.org/10.1016/j.lwt.2016.08.055

Cacace, J. E., & Mazza, G. (2003). Mass transfer process during extraction of phenolic compounds from milled berries. *Journal of Food Engineering*, *59*(4), 379–389. https://doi.org/10.1016/S0260-8774(02)00497-1

Cacique, A. P., Barbosa, É. S., de Pinho, G. P., & Silvério, F. O. (2020). Maceration extraction conditions for determining the phenolic compounds and the antioxidant activity of catharanthus roseus (L.) g. don. *Ciencia e Agrotecnologia*, *44*, 1–12. https://doi.org/10.1590/1413-7054202044017420

Campoccia, D., Ravaioli, S., Santi, S., Mariani, V., Santarcangelo, C., De Filippis, A., Montanaro, L., Arciola, C. R., & Daglia, M. (2021). Exploring the anticancer effects of standardized extracts of poplar-type propolis: In vitro cytotoxicity toward cancer and normal cell lines. *Biomedicine and Pharmacotherapy*, *141*, 111895. https://doi.org/10.1016/j.biopha.2021.111895

Campos, J. F., Das Santos, U. P., Da Rocha, P. D. S., Damião, M. J., Balestieri, J. B. P., Cardoso, C. A. L., Paredes-Gamero, E. J., Estevinho, L. M., De Picoli Souza, K., & Dos Santos, E. L. (2015). Antimicrobial, Antioxidant, Anti-Inflammatory, and Cytotoxic Activities of Propolis from the Stingless Bee Tetragonisca fiebrigi (Jataí). *Evidence-Based Complementary and Alternative Medicine*, *2015*. https://doi.org/10.1155/2015/296186

Cañedo-Dorantes, L., & Cañedo-Ayala, M. (2019). Skin acute wound healing: A comprehensive review. *International Journal of Inflammation*, *2019*. https://doi.org/10.1155/2019/3706315

Cao, X. P., Chen, Y. F., Zhang, J. L., You, M. M., Wang, K., & Hu, F. L. (2017a). Mechanisms underlying the wound healing potential of propolis based on its in vitro antioxidant activity. *Phytomedicine*, *34*(December 2016), 76–84. https://doi.org/10.1016/j.phymed.2017.06.001

Cao, X. P., Chen, Y. F., Zhang, J. L., You, M. M., Wang, K., & Hu, F. L. (2017b). Mechanisms underlying the wound healing potential of propolis based on its in vitro antioxidant activity. *Phytomedicine*, *34*(April), 76–84. https://doi.org/10.1016/j.phymed.2017.06.001

Carvalho, A. A., Finger, D., MacHado, C. S., Schmidt, E. M., Costa, P. M. Da, Alves, A. P. N. N., Morais, T. M. F., Queiroz, M. G. R. De, Quináia, S. P., Rosa, M. R. Da, Santos, J. M. T. Dos, Pessoa, C., Moraes, M. O. De, Costa-Lotufo, L. V., Sawaya, A. C. H. F., Eberlin, M. N., & Torres, Y. R. (2011). In vivo antitumoural activity and composition of an oil extract of Brazilian propolis. *Food Chemistry*, *126*(3), 1239–1245. https://doi.org/10.1016/j.foodchem.2010.12.035

Cavalaro, R. I., Cruz, R. G. da, Dupont, S., de Moura Bell, J. M. L. N., & Vieira, T. M. F. de S. (2019). In vitro and in vivo antioxidant properties of bioactive compounds from green propolis obtained by ultrasound-assisted extraction. *Food Chemistry: X*, *4*(September), 100054. https://doi.org/10.1016/j.fochx.2019.100054

Cerretani, L., & Bendini, A. (2010). Rapid Assays to Evaluate the Antioxidant Capacity of Phenols in Virgin Olive Oil. In *Olives and Olive Oil in Health and Disease Prevention*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-374420-3.00067-X

Chaiklahan, R., Chirasuwan, N., Triratana, P., Tia, S., & Bunnag, B. (2014). Effect of extraction temperature on the diffusion coefficient of polysaccharides from Spirulina and the optimal separation method. *Biotechnology and Bioprocess Engineering*, *19*(2), 369–377. https://doi.org/10.1007/s12257-013-0733-2

Chandra, R., Vishal, G., Sánchez, C. E. G., & Uribe, J. A. G. (2020). Bioreactor for algae cultivation and biodiesel production. In *Bioreactors: Sustainable Design and Industrial Applications in Mitigation of GHG Emissions*. INC. https://doi.org/10.1016/B978-0-12-821264-6.00015-2

Chang, J. H., Cho, J. H., Kim, H. H., Lee, K. P., Lee, M. W., Han, S. S., & Lee, D. I. (1995). Antitumor activity of pedunculagin, one of the ellagitannin. *Archives of Pharmacal Research*, *18*(6), 396–401. https://doi.org/10.1007/BF02976342

Che Sulaiman, I. S., Basri, M., Fard Masoumi, H. R., Chee, W. J., Ashari, S. E., & Ismail, M. (2017). Effects of temperature, time, and solvent ratio on the extraction of phenolic compounds and the anti-radical activity of Clinacanthus nutans Lindau leaves by response surface methodology. *Chemistry Central Journal*, *11*(1), 1–11. https://doi.org/10.1186/s13065-017-0285-1

Chedea, V. S., & Pop, R. M. (2019). Total Polyphenols Content and Antioxidant DPPH Assays on Biological Samples. In *Polyphenols in Plants* (2nd ed.). Elsevier Inc. https://doi.org/10.1016/b978-0-12-813768-0.00011-6

Cheila, C. B., dos Anjos, G. L., Nóbrega, R. S. A., da S. Magaton, A., de Miranda, F. M., & de S. Dias, F. (2020). Greener ultrasound-assisted extraction of bioactive phenolic compounds in Croton heliotropiifolius Kunth leaves. *Microchemical Journal*, *159*(June). https://doi.org/10.1016/j.microc.2020.105525

Chen, M., Zhao, Y., & Yu, S. (2015). Optimisation of ultrasonic-assisted extraction of phenolic compounds, antioxidants, and anthocyanins from sugar beet molasses. *Food Chemistry*, *172*, 543–550. https://doi.org/10.1016/j.foodchem.2014.09.110

Chen, R., Jin, C., Tong, Z., Lu, J., Tan, L., Tian, L., & Chang, Q. (2016). Optimization extraction, characterization and antioxidant activities of pectic polysaccharide from tangerine peels. *Carbohydrate Polymers*, *136*, 187–197. https://doi.org/10.1016/j.carbpol.2015.09.036

Chen, Y. T., Kao, W. T., & Lin, K. W. (2008). Effects of pH on the total phenolic compound, antioxidative ability and the stability of dioscorin of various yam cultivars. *Food Chemistry*, *107*(1), 250–257. https://doi.org/10.1016/j.foodchem.2007.08.017

Cheng, H. S., Ton, S. H., & Abdul Kadir, K. (2017). Ellagitannin geraniin: a review of the natural sources, biosynthesis, pharmacokinetics and biological effects. In *Phytochemistry Reviews* (Vol. 16, Issue 1). Springer Netherlands. https://doi.org/10.1007/s11101-016-9464-2

Chew, K. K., Khoo, M. Z., Ng, S. Y., Thoo, Y. Y., Aida, W. M. W., & Ho, C. W. (2011). Effect of ethanol concentration, extraction time and extraction temperature on the recovery of phenolic compounds and antioxidant capacity of Orthosiphon stamineus extracts. *International Food Research Journal*, *18*(4), 1427–1435.

Chew, K. K., Ng, S. Y., Thoo, Y. Y., Khoo, M. Z., Wan Aida, W. M., & Ho, C. W. (2011a). Effect of ethanol concentration, extraction time and extraction temperature on the recovery of phenolic compounds and antioxidant capacity of Centella asiatica extracts. *International Food Research Journal*, *18*(2), 571–578.

Chew, K. K., Ng, S. Y., Thoo, Y. Y., Khoo, M. Z., Wan Aida, W. M., & Ho, C. W. (2011b). Effect of ethanol concentration, extraction time and extraction temperature on the recovery of phenolic compounds and antioxidant capacity of Centella asiatica extracts. *International Food Research Journal*, *18*(2), 571–578.

Christov, R., Trusheva, B., Popova, M., Bankova, V., & Bertrand, M. (2006). Chemical composition of propolis from Canada, its antiradical activity and plant origin. *Natural Product Research*, *20*(6), 531–536. https://doi.org/10.1080/14786410500056918

Chu, K. T., & Ng, T. B. (2006). Smilaxin, a novel protein with immunostimulatory, antiproliferative, and HIV-1-reverse transcriptase inhibitory activities from fresh

Smilax glabra rhizomes. *Biochemical and Biophysical Research Communications*, *340*(1), 118–124. https://doi.org/10.1016/j.bbrc.2005.12.010

Çilenk, K. T., Öztürk, İ., & Sönmez, M. F. (2016). Ameliorative effect of propolis on the cadmium-induced reproductive toxicity in male albino rats. *Experimental and Molecular Pathology*, *101*(2), 207–213. https://doi.org/10.1016/j.yexmp.2016.08.004

Cilia, G., Analysis, A. E., Fratini, F., & Tafi, E. (2020). *Microbial Profile of the Ventriculum of Honey Bee (Apis mellifera ligustica Spinola , 1806) Fed with Veterinary Drugs , Dietary Supplements and Non- Protein Amino Acids*. *June*. https://doi.org/10.3390/vetsci7020076

Clark, C., & Williges, R. C. (1973). Response Surface Methodology Central-Composite Design Modifications for Human Performance Research. *Human Factors: The Journal of Human Factors and Ergonomics Society*, *15*(4), 295–310. https://doi.org/10.1177/001872087301500402

Copes, F., Ramella, M., Fusaro, L., Mantovani, D., Cannas, M., & Boccafoschi, F. (2019). Pleiotrophin: Analysis of the endothelialisation potential. *Advances in Medical Sciences*, *64*(1), 144–151. https://doi.org/10.1016/j.advms.2018.08.007

Corrêa, F. R. S., Schanuel, F. S., Moura-Nunes, N., Monte-Alto-Costa, A., & Daleprane, J. B. (2017a). Brazilian red propolis improves cutaneous wound healing suppressing inflammation-associated transcription factor NFκB. *Biomedicine and Pharmacotherapy*, *86*, 162–171. https://doi.org/10.1016/j.biopha.2016.12.018

Corrêa, F. R. S., Schanuel, F. S., Moura-Nunes, N., Monte-Alto-Costa, A., & Daleprane, J. B. (2017b). Brazilian red propolis improves cutaneous wound healing suppressing inflammation-associated transcription factor NFκB. *Biomedicine and Pharmacotherapy*, *86*, 162–171. https://doi.org/10.1016/j.biopha.2016.12.018

Cottica, S. M., Sawaya, A. C. H. F., Eberlin, M. N., Franco, S. L., Zeoula, L. M., & Visentainer, J. V. (2011). Antioxidant activity and composition of propolis obtained by different methods of extraction. *Journal of the Brazilian Chemical Society*, *22*(5), 929–935. https://doi.org/10.1590/S0103-50532011000500016

Ćujić, N., Šavikin, K., Janković, T., Pljevljakušić, D., Zdunić, G., & Ibrić, S. (2016). Optimization of polyphenols extraction from dried chokeberry using maceration as traditional technique. *Food Chemistry*, *194*, 135–142. https://doi.org/10.1016/j.foodchem.2015.08.008

Cunha, I. B. S., Sawaya, A. C. H. F., Caetano, F. M., Shimizu, M. T., Marcucci, M. C., Drezza, F. T., Povia, G. S., & Carvalho, P. D. O. (2004). Factors that influence the yield and composition of Brazilian propolis extracts. *Journal of the Brazilian Chemical Society*, *15*(6), 964–970. https://doi.org/10.1590/S0103-50532004000600026

Cvek, J., Medić-Šarić, M., Jasprica, I., Zubčić, S., Vitali, D., Mornar, A., Vedrina-Dragojević, I., & Tomić, S. (2007). Optimisation of an extraction procedure and

chemical characterisation of Croatian propolis tinctures. *Phytochemical Analysis*, *18*(5), 451–459. https://doi.org/10.1002/pca.1001

Czyzewska, U., Siemionow, K., Zareba, I., & Miltyk, W. (2016). Proapoptotic activity of propolis and their components on human tongue squamous cell carcinoma cell line (CAL-27). *PLoS ONE*, *11*(6), 1–14. https://doi.org/10.1371/journal.pone.0157091

da Cruz Almeida, E. T., da Silva, M. C. D., Oliveira, J. M. dos S., Kamiya, R. U., Arruda, R. E. dos S., Vieira, D. A., Silva, V. da C., Escodro, P. B., Basílio-Júnior, I. D., & do Nascimento, T. G. (2017). Chemical and microbiological characterization of tinctures and microcapsules loaded with Brazilian red propolis extract. *Journal of Pharmaceutical Analysis*, *7*(5), 280–287. https://doi.org/10.1016/j.jpha.2017.03.004

da Silva, C., Prasniewski, A., Calegari, M. A., de Lima, V. A., & Oldoni, T. L. C. (2018). Determination of Total Phenolic Compounds and Antioxidant Activity of Ethanolic Extracts of Propolis Using ATR–FT-IR Spectroscopy and Chemometrics. *Food Analytical Methods*, *11*(7), 2013–2021. https://doi.org/10.1007/s12161-018-1161-x

da Silva, I. A. A., da Silva, T. M. S., Camara, C. A., Queiroz, N., Magnani, M., de Novais, J. S., Soledade, L. E. B., Lima, E. de O., de Souza, A. L., & de Souza, A. G. (2013). Phenolic profile, antioxidant activity and palynological analysis of stingless bee honey from Amazonas, Northern Brazil. *Food Chemistry*, *141*(4), 3552–3558. https://doi.org/10.1016/j.foodchem.2013.06.072

Danlami, J. M., Arsad, A., Zaini, M. A. A., & Sulaiman, H. (2014). A comparative study of various oil extraction techniques from plants. *Reviews in Chemical Engineering*, *30*(6), 605–626. https://doi.org/10.1515/revce-2013-0038

Darendelioglu, E., Aykutoglu, G., Tartik, M., & Baydas, G. (2016). Turkish propolis protects human endothelial cells in vitro from homocysteine-induced apoptosis. *Acta Histochemica*, *118*(4), 369–376. https://doi.org/10.1016/j.acthis.2016.03.007

das Neves, M. V. M., da Silva, T. M. S., de Oliveira Lima, E., da Cunha, E. V. L., & Oliveira, E. de J. (2016). Isoflavone formononetin from red propolis acts as a fungicide against Candida sp. *Brazilian Journal of Microbiology*, *47*(1), 159–166. https://doi.org/10.1016/j.bjm.2015.11.009

De Almeida, E. B., Cordeiro Cardoso, J., Karla De Lima, A., De Oliveira, N. L., De Pontes-Filho, N. T., Oliveira Lima, S., Leal Souza, I. C., & De Albuquerque-Júnior, R. L. C. (2013). The incorporation of Brazilian propolis into collagen-based dressing films improves dermal burn healing. *Journal of Ethnopharmacology*, *147*(2), 419–425. https://doi.org/10.1016/j.jep.2013.03.031

de Funari, C. S., de Oliveira Ferro, V., & Mathor, M. B. (2007). Analysis of propolis from Baccharis dracunculifolia DC. (Compositae) and its effects on mouse fibroblasts. *Journal of Ethnopharmacology*, *111*(2), 206–212. https://doi.org/10.1016/j.jep.2006.11.032

De, L. (2020). *ORCHID WEALTH FOR IMMUNITY DEVELOPMENT-AN OVERVIEW*. *9*(4), 647–655.

de Mendonça, I. C. G., Porto, I. C. C. de M., do Nascimento, T. G., de Souza, N. S., Oliveira, J. M. dos S., Arruda, R. E. dos S., Mousinho, K. C., dos Santos, A. F., Basílio-Júnior, I. D., Parolia, A., & Barreto, F. S. (2015). Brazilian red propolis: Phytochemical screening, antioxidant activity and effect against cancer cells. *BMC Complementary and Alternative Medicine*, *15*(1), 1–12. https://doi.org/10.1186/s12906-015-0888-9

de Morais, D. V., Rosalen, P. L., Ikegaki, M., Silva, A. P. de S., Massarioli, A. P., & de Alencar, S. M. (2021). Active antioxidant phenolics from brazilian red propolis: An optimization study for their recovery and identification by lc-esi-qtof-ms/ms. *Antioxidants*, *10*(2), 1–16. https://doi.org/10.3390/antiox10020297

de Oliveira, M. S., Cruz, J. N., Ferreira, O. O., Pereira, D. S., Pereira, N. S., Oliveira, M. E. C., Venturieri, G. C., Guilhon, G. M. S. P., Souza Filho, A. P. da S., & Andrade, E. H. de A. (2021). Chemical composition of volatile compounds in apis mellifera propolis from the northeast region of pará state, brazil. *Molecules*, *26*(11), 1–12. https://doi.org/10.3390/molecules26113462

Deephashree C. Lingegowda, J. Komal Kumar, A. G. Devi Prasad, Mahsa Zarei, S. G. (2013). Ftir Spectroscopic Studies on Cleome Gynandra – Comparative. *Romanian Journal of Biophysics*, *22*(June 2014), 137–143.

Deng, Z., Hassan, S., Rafiq, M., Li, H., He, Y., Cai, Y., Kang, X., Liu, Z., & Yan, T. (2020). Pharmacological Activity of Eriodictyol: The Major Natural Polyphenolic Flavanone. *Evidence-Based Complementary and Alternative Medicine*, *2020*. https://doi.org/10.1155/2020/6681352

Dent, M., Dragović-Uzelac, V., Penić, M., Brñić, M., Bosiljkov, T., & Levaj, B. (2013). The effect of extraction solvents, temperature and time on the composition and mass fraction of polyphenols in dalmatian wild sage (Salvia officinalis L.) extracts. *Food Technology and Biotechnology*, *51*(1), 84–91.

Devakumar, J., Keerthana, V., & Ss, S. (2017). *IDENTIFICATION OF BIOACTIVE COMPOUNDS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY ANALYSIS OF SYZYGIUM JAMBOS (L .) COLLECTED FROM WESTERN GHATS REGION COIMBATORE , TAMIL NADU*. *10*(1).

Ding, Q., Wu-Chen, R. A., Wu, Q., Jiang, H., Zhang, T., Luo, L., Ma, H., Ma, S., & He, R. (2019). Kinetics of ultrasound-assisted extraction of flavonoids and triterpenes and structure characterization of chinese northeast black bee propolis. *Chiang Mai Journal of Science*, *46*(1), 72–92.

Do, Q. D., Angkawijaya, A. E., Tran-Nguyen, P. L., Huynh, L. H., Soetaredjo, F. E., Ismadji, S., & Ju, Y. H. (2014). Effect of extraction solvent on total phenol content, total flavonoid content, and antioxidant activity of Limnophila aromatica. *Journal of Food and Drug Analysis*, *22*(3), 296–302. https://doi.org/10.1016/j.jfda.2013.11.001

do Santos, R. C., de Souza, A. V., Andrade-Silva, M., Vera Cruz, karoliny C., Leite Kassuya, C. A., Lima Cardoso, C. A., Vieira, M. do C., & Nazari Formagio, A. S. (2018). Antioxidant, anti-rheumatic and anti-inflammatory investigation of extract and dicentrinone from Duguetia furfuracea (A. St.-Hil.) Benth. & Hook. f. *Journal of Ethnopharmacology*, *211*(September 2017), 9–16. https://doi.org/10.1016/j.jep.2017.09.019

Donmez, M., Karadeniz, S., Yoldas, T., Aydin, G., Karagul, P., Aksu, O., & Rasgele, P. G. (2020). Comparison of Chemical Contents of Extracts in Different Solvents of Propolis Samples Produced in Duzce Province. *International Journal of Traditional and Complementary Medicine Research*, *1*(3), 137–146.

Dorsey, B. M., & Jones, M. A. (2017). Healthy components of coffee processing by-products. In *Handbook of Coffee Processing By-Products: Sustainable Applications*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-811290-8.00002-5

Dunnill, C., Patton, T., Brennan, J., Barrett, J., Dryden, M., Cooke, J., Leaper, D., & Georgopoulos, N. T. (2017a). Reactive oxygen species (ROS) and wound healing: the functional role of ROS and emerging ROS-modulating technologies for augmentation of the healing process. *International Wound Journal*, *14*(1), 89–96. https://doi.org/10.1111/iwj.12557

Dunnill, C., Patton, T., Brennan, J., Barrett, J., Dryden, M., Cooke, J., Leaper, D., & Georgopoulos, N. T. (2017b). Reactive oxygen species (ROS) and wound healing: the functional role of ROS and emerging ROS-modulating technologies for augmentation of the healing process. *International Wound Journal*, *14*(1), 89–96. https://doi.org/10.1111/iwj.12557

Duy, N. Q., Binh, M. L. T., Thuan, M., Van, N. T. T., Lam, T. D., Tran, T. H., & Nhan, P. N. T. (2019). Effects of extraction conditions on total phenolic content and total flavonoid content of roselle (Hibiscus sabdariffa l.) extracts. *Key Engineering Materials*, *814 KEM*, 469–474. https://doi.org/10.4028/www.scientific.net/KEM.814.469

Dymarska, M., Janeczko, T., & Kostrzewa-Susłow, E. (2018). Glycosylation of 3-Hydroxyflavone, 3-Methoxyflavone, quercetin and baicalein in fungal cultures of the genus isaria. *Molecules*, *23*(10). https://doi.org/10.3390/molecules23102477

Ebadi, P., & Fazeli, M. (2017). Anti-photoaging potential of propolis extract in UVB-irradiated human dermal fibroblasts through increasing the expression of FOXO3A and NGF genes. *Biomedicine and Pharmacotherapy*, *95*, 47–54. https://doi.org/10.1016/j.biopha.2017.08.019

El-Aidy, W. K., Ebeid, A. A., Sallam, A. E. R. M., Muhammad, I. E., Abbas, A. T., Kamal, M. A., & Sohrab, S. S. (2015). Evaluation of propolis, honey, and royal jelly in amelioration of peripheral blood leukocytes and lung inflammation in mouse conalbumin-induced asthma model. *Saudi Journal of Biological Sciences*, *22*(6), 780–788. https://doi.org/10.1016/j.sjbs.2014.11.005

El-Haskoury, R., Kriaa, W., Lyoussi, B., & Makni, M. (2018). Ceratonia siliqua honeys from Morocco: Physicochemical properties, mineral contents, and antioxidant

activities. *Journal of Food and Drug Analysis*, *26*(1), 67–73. https://doi.org/10.1016/j.jfda.2016.11.016

El-Mossalami, H., & Abdel-Hakeim, Y. (2013). Using of Propolis Extract As a Trial To Extend the Shelf-Life and Improving the Quality Criteria of Fresh Egyptian Sausage. *Assiut Veterinary Medical Journal*, *59*(139), 23–33. https://doi.org/10.21608/avmj.2013.171899

El Ashry, E. S. H., & Ahmad, T. A. (2012). The use of propolis as vaccine's adjuvant. *Vaccine*, *31*(1), 31–39. https://doi.org/10.1016/j.vaccine.2012.10.095

Elkhenany, H., El-Badri, N., & Dhar, M. (2019). Green propolis extract promotes in vitro proliferation, differentiation, and migration of bone marrow stromal cells. *Biomedicine and Pharmacotherapy*, *115*(July). https://doi.org/10.1016/j.biopha.2019.108861

Endang, A., Hasan, Z., Artika, I. M., & Tukan, G. D. (2014). *Analysis of Active Components of Trigona spp Propolis from Pandeglang Indonesia*. *3*(1), 215–219.

Erdogan, S., Ates, B., Durmaz, G., Yilmaz, I., & Seckin, T. (2011). Pressurized liquid extraction of phenolic compounds from Anatolia propolis and their radical scavenging capacities. *Food and Chemical Toxicology*, *49*(7), 1592–1597. https://doi.org/10.1016/j.fct.2011.04.006

Esclapez, M. D., García-Pérez, J. V., Mulet, A., & Cárcel, J. A. (2011). Ultrasound-Assisted Extraction of Natural Products. *Food Engineering Reviews*, *3*(2), 108–120. https://doi.org/10.1007/s12393-011-9036-6

Eskandarinia, A., Kefayat, A., Rafienia, M., Agheb, M., Navid, S., & Ebrahimpour, K. (2019). Cornstarch-based wound dressing incorporated with hyaluronic acid and propolis: In vitro and in vivo studies. *Carbohydrate Polymers*, *216*(March), 25–35. https://doi.org/10.1016/j.carbpol.2019.03.091

Everette, J. D., Bryant, Q. M., Green, A. M., Abbey, Y. A., Wangila, G. W., & Walker, R. B. (2010). *A THOROUGH STUDY OF REACTIVITY OF VARIOUS COMPOUND CLASSES TOWARDS THE FOLIN-CIOCALTEU*. *58*(14), 8139–8144. https://doi.org/10.1021/jf1005935.A

Fachri, B. A., Sari, P., Yuwanti, S., & Subroto, E. (2020). Experimental study and modeling on supercritical CO2 extraction of Indonesian raw propolis using response surface method: Influence of pressure, temperature and CO2 mass flowrate on extraction yield. *Chemical Engineering Research and Design*, *153*, 452–462. https://doi.org/10.1016/j.cherd.2019.11.014

Fadjare Frempong, T., Owusu Boadi, N., & Badu, M. (2021). Optimization of extraction conditions for polyphenols from the stem bark of Funtumia elastica (Funtum) utilizing response surface methodology. *AAS Open Research*, *4*, 46. https://doi.org/10.12688/aasopenres.13284.1

Fan, C., Wu, L. H., Zhang, G. F., Xu, F., Zhang, S., Zhang, X., Sun, L., Yu, Y., Zhang, Y., & Ye, R. D. (2017). 4'-Hydroxywogonin suppresses lipopolysaccharide-induced inflammatory responses in RAW 264.7 macrophages and acute lung

injury mice. *PLoS ONE*, *12*(8), 1–17. https://doi.org/10.1371/journal.pone.0181191

Fico, D., Margapoti, E., Pennetta, A., & De Benedetto, G. E. (2018). An enhanced GC/MS procedure for the identification of proteins in paint microsamples. *Journal of Analytical Methods in Chemistry*, *2018*. https://doi.org/10.1155/2018/6032084

Floegel, A., Kim, D. O., Chung, S. J., Koo, S. I., & Chun, O. K. (2011). Comparison of ABTS/DPPH assays to measure antioxidant capacity in popular antioxidant-rich US foods. *Journal of Food Composition and Analysis*, *24*(7), 1043–1048. https://doi.org/10.1016/j.jfca.2011.01.008

Francenia Santos-Sánchez, N., Salas-Coronado, R., Villanueva-Cañongo, C., & Hernández-Carlos, B. (2019). Antioxidant Compounds and Their Antioxidant Mechanism. *Antioxidants*, 1–28. https://doi.org/10.5772/intechopen.85270

Freires, I. A., De Alencar, S. M., & Rosalen, P. L. (2016). A pharmacological perspective on the use of Brazilian Red Propolis and its isolated compounds against human diseases. *European Journal of Medicinal Chemistry*, *110*, 267–279. https://doi.org/10.1016/j.ejmech.2016.01.033

Freires, I. A., Queiroz, V. C. P. P., Furletti, V. F., Ikegaki, M., de Alencar, S. M., Duarte, M. C. T., & Rosalen, P. L. (2016a). Chemical composition and antifungal potential of Brazilian propolis against Candida spp. *Journal de Mycologie Medicale*, *26*(2), 122–132. https://doi.org/10.1016/j.mycmed.2016.01.003

Freires, I. A., Queiroz, V. C. P. P., Furletti, V. F., Ikegaki, M., de Alencar, S. M., Duarte, M. C. T., & Rosalen, P. L. (2016b). Chemical composition and antifungal potential of Brazilian propolis against Candida spp. *Journal de Mycologie Medicale*, *26*(2), 122–132. https://doi.org/10.1016/j.mycmed.2016.01.003

Frozza, C. O. da S., Santos, D. A., Rufatto, L. C., Minetto, L., Scariot, F. J., Echeverrigaray, S., Pich, C. T., Moura, S., Padilha, F. F., Borsuk, S., Savegnago, L., Collares, T., Seixas, F. K., Dellagostin, O., Roesch-Ely, M., & Henriques, J. A. P. (2017). Antitumor activity of Brazilian red propolis fractions against Hep-2 cancer cell line. *Biomedicine and Pharmacotherapy*, *91*(2017), 951–963. https://doi.org/10.1016/j.biopha.2017.05.027

Fu, R. H., Tsai, C. W., Tsai, R. T., Liu, S. P., Chan, T. M., Ho, Y. C., Lin, H. L., Chen, Y. M., Hung, H. S., Chiu, S. C., Tsai, C. H., Wang, Y. C., Shyu, W. C., & Lin, S. Z. (2015). Irisflorentin modifies properties of mouse bone marrow-derived dendritic cells and reduces the allergic contact hypersensitivity responses. *Cell Transplantation*, *24*(3), 573–588. https://doi.org/10.3727/096368915X687002

Galeotti, F., Maccari, F., Fachini, A., & Volpi, N. (2018). Chemical composition and antioxidant activity of propolis prepared in different forms and in different solvents useful for finished products. *Foods*, *7*(3). https://doi.org/10.3390/foods7030041

Galili, S., & Hovav, R. (2014). Determination of Polyphenols, Flavonoids, and Antioxidant Capacity in Dry Seeds. In *Polyphenols in Plants: Isolation, Purification and Extract Preparation*. Elsevier. https://doi.org/10.1016/B978-0-12-397934-6.00016-4

Gema, M.-O., Marlon, R.-L., Joel, D.-R., Flor de Fatima, R. C., & Silvia, L.-S. (2020). Effect of Ethanol and Methanol on the Total Phenolic Content and Antioxidant Capacity of Chia Seeds (Salvia hispanica L .). *Sains Malaysiana*, *49*(6), 1283–1292.

Ghafoor, K., & Choi. (2009). Optimization of Ultrasound Assisted Extraction of Phenolic Compounds and Antioxidants from Grape Peel through Response Surface Methodology. *Journal of the Korean Society for Applied Biological Chemistry*, *52*(3), 295–300. https://doi.org/10.3839/jksabc.2009.052

Gogate, P. R. (2008). Cavitational reactors for process intensification of chemical processing applications: A critical review. *Chemical Engineering and Processing: Process Intensification*, *47*(4), 515–527. https://doi.org/10.1016/j.cep.2007.09.014

Goldstein, D. B. (1986). Effect of alcohol on cellular membranes. *Annals of Emergency Medicine*, *15*(9), 1013–1018. https://doi.org/10.1016/S0196-0644(86)80120-2

Golmahi, Z., & Elhamirad, A. H. (2021). Ultrasound-Assisted Extraction of Phenolics and Antioxidants from Propolis for Stabilization of Sunflower Oil. *Revista de Ciencias Agrícolas*, *38*(1), 4–19. https://doi.org/10.22267/rcia.213801.141

Gomez, L., Tiwari, B., & Garcia-Vaquero, M. (2020). Emerging extraction techniques: Microwave-assisted extraction. In *Sustainable Seaweed Technologies*. Elsevier Inc. https://doi.org/10.1016/b978-0-12-817943-7.00008-1

González-Centeno, M. R., Comas-Serra, F., Femenia, A., Rosselló, C., & Simal, S. (2015). Effect of power ultrasound application on aqueous extraction of phenolic compounds and antioxidant capacity from grape pomace (Vitis vinifera L.): Experimental kinetics and modeling. *Ultrasonics Sonochemistry*, *22*, 506–514. https://doi.org/10.1016/j.ultsonch.2014.05.027

Gonzalez, A. C. D. O., Andrade, Z. D. A., Costa, T. F., & Medrado, A. R. A. P. (2016). Wound healing - A literature review. *Anais Brasileiros de Dermatologia*, *91*(5), 614–620. https://doi.org/10.1590/abd1806-4841.20164741

Gregoris, E., & Stevanato, R. (2010). Correlations between polyphenolic composition and antioxidant activity of Venetian propolis. *Food and Chemical Toxicology*, *48*(1), 76–82. https://doi.org/10.1016/j.fct.2009.09.018

Griffin, S. P., & Bhagooli, R. (2004). Measuring antioxidant potential in corals using the FRAP assay. *Journal of Experimental Marine Biology and Ecology*, *302*(2), 201–211. https://doi.org/10.1016/j.jembe.2003.10.008

Guerrero-Pérez, M. O., & Patience, G. S. (2020). Experimental methods in chemical engineering: Fourier transform infrared spectroscopy—FTIR. *Canadian Journal of Chemical Engineering*, *98*(1), 25–33. https://doi.org/10.1002/cjce.23664

Güney, M., & Elik, A. (2017). Comparison of Probe with Bath Ultrasonic Leaching Procedures for Preparation to Heavy Metal Analysis of Bio-Collectors Prior to Atomic Absorption Spectrometry. *Communications in Soil Science and Plant Analysis*, *48*(15), 1741–1752. https://doi.org/10.1080/00103624.2017.1395444

Gushiken, L. F. S., Beserra, F. P., Bastos, J. K., Jackson, C. J., & Pellizzon, C. H. (2021). Cutaneous wound healing: An update from physiopathology to current therapies. *Life*, *11*(7), 1–15. https://doi.org/10.3390/life11070665

Ha, G. S., & Kim, J. H. (2016). Kinetic and thermodynamic characteristics of ultrasound-assisted extraction for recovery of paclitaxel from biomass. *Process Biochemistry*, *51*(10), 1664–1673. https://doi.org/10.1016/j.procbio.2016.08.012

Hagar, A., Rani, N. F. A., Ibrahim, M., Ramli, N., Ahmed, I. A., Jalil, A. M. M., & Anuar, M. N. N. (2021). Optimization of extraction temperature and time on phenolic compounds and antioxidant activity of malaysian propolis trigona spp. Aqueous extract using response surface methodology. *Malaysian Journal of Analytical Sciences*, *25*(4), 649–660.

Haghdoost, N. S., Salehi, T. Z., Khosravi, A., & Sharifzadeh, A. (2016). Activité antifongique et l'influence de propolis contre la formation de germ tube, facteur de virulence critique d'isolats cliniques de Candida albicans. *Journal de Mycologie Medicale*, *26*(4), 298–305. https://doi.org/10.1016/j.mycmed.2015.11.004

Hamzah, N., & Leo, C. P. (2015). Microwave-Assisted extraction of trigona propolis: The effects of processing parameters. *International Journal of Food Engineering*, *11*(6), 861–870. https://doi.org/10.1515/ijfe-2015-0106

HARDIANTI, B., UMEYAMA, L., LI, F., YOKOYAMA, S., & HAYAKAWA, Y. (2020). Anti-inflammatory compounds moracin O and P from Morus alba Linn. (Sohakuhi) target the NF-κB pathway. *Molecular Medicine Reports*, *22*(6), 5385–5391. https://doi.org/10.3892/mmr.2020.11615

Harouna-Oumarou, H. A., Fauduet, H., Porte, C., & Ho, Y. S. (2007). Comparison of kinetic models for the aqueous solid-liquid extraction of Tilia sapwood a continuous stirred tank reactor. *Chemical Engineering Communications*, *194*(4), 537–552. https://doi.org/10.1080/00986440600992511

Harper, D., Young, A., & McNaught, C. E. (2014). The physiology of wound healing. *Surgery (United Kingdom)*, *32*(9), 445–450. https://doi.org/10.1016/j.mpsur.2014.06.010

Hegazi, A. G., El-Hady, F. K. A., Shaker, K. H., Modear, N., & Houcine, S. (2012). Inhibitory effect of Algerian propolis on viral, microbial infection and ldl peroxidation with correlation to its chemical composition. *Mellifera*, *12*(23), 2–11.

Hemmalakshmi, S., Priyanga, S., & Devaki, K. (2017). Fourier transform infra-red spectroscopy analysis of Erythrina variegata L. *Journal of Pharmaceutical Sciences and Research*, *9*(11), 2062–2067.

Henry, L. J. K., Ramar, M. K., Palanisamy, S., Natesan, S., & Kandasamy, R. (2020). Mechanistic investigation of PPARγ-facilitated anti-asthmatic effects of Galangin (Norizalpinin): Insights from in silico and in vivo analyses. *Biochemical and Biophysical Research Communications*, *526*(3), 833–840. https://doi.org/10.1016/j.bbrc.2020.03.158

Henshaw, F. R., Bolton, T., Nube, V., Hood, A., Veldhoen, D., Pfrunder, L., McKew, G. L., MacLeod, C., McLennan, S. V., & Twigg, S. M. (2014). Topical application of the bee hive protectant propolis is well tolerated and improves human diabetic foot ulcer healing in a prospective feasibility study. *Journal of Diabetes and Its Complications*, *28*(6), 850–857. https://doi.org/10.1016/j.jdiacomp.2014.07.012

Hidaka, S., Okamoto, Y., Ishiyama, K., & Hashimoto, K. (2008). Inhibition of the formation of oral calcium phosphate precipitates: The possible effects of certain honeybee products. *Journal of Periodontal Research*, *43*(4), 450–458. https://doi.org/10.1111/j.1600-0765.2008.01088.x

Hirakura, K., Morita, M., Nakajima, K., Sugama, K., Takagi, K., Niitsu, K., Ikeya, Y., Maruno, M., & Okada, M. (1997). Phenolic glucosides from the root of Pueraria lobata. *Phytochemistry*, *46*(5), 921–928. https://doi.org/10.1016/S0031-9422(97)00371-3

Hobbi, P., Okoro, O. V., Delporte, C., Alimoradi, H., Podstawczyk, D., Nie, L., Bernaerts, K. V., & Shavandi, A. (2021). Kinetic modelling of the solid–liquid extraction process of polyphenolic compounds from apple pomace: influence of solvent composition and temperature. *Bioresources and Bioprocessing*, *8*(1). https://doi.org/10.1186/s40643-021-00465-4

Hozzein, W. N., Badr, G., Al Ghamdi, A. A., Sayed, A., Al-Waili, N. S., & Garraud, O. (2015). Topical application of propolis enhances cutaneous wound healing by promoting TGF-beta/smad-mediated collagen production in a streptozotocin-induced type I diabetic mouse model. *Cellular Physiology and Biochemistry*, *37*(3), 940–954. https://doi.org/10.1159/000430221

Hyun, S. K., Lee, W. H., Jeong, D. M., Kim, Y., & Choi, J. S. (2008). Inhibitory effects of kurarinol, kuraridinol, and trifolirhizin from Sophora flavescens on tyrosinase and melanin synthesis. *Biological and Pharmaceutical Bulletin*, *31*(1), 154–158. https://doi.org/10.1248/bpb.31.154

Ibrahim, N., Ibrahim, N., Zakaria, A. J., Ismail, Z., Ahmad, Y., & Mod, K. S. (2018). Application of GCMS and FTIR Fingerprinting in Discriminating Two Species of Malaysian Stingless Bees Propolis. *International Journal of Engineering & Technology*, *7*(4.43), 106–112. https://www.sciencepubco.com/index.php/ijet/article/view/25828

Ismail, T. N. N. T., Sulaiman, S. A., Ponnuraj, K. T., Man, C. N., & Hassan, N. B. (2018). Chemical constituents of Malaysian apis mellifera propolis. *Sains Malaysiana*, *47*(1), 117–122. https://doi.org/10.17576/jsm-2018-4701-14

Ismail, W. I. W., Hussin, N. N., Mazlan, S. N. F., Hussin, N. H., & Radzi, M. N. F. M. (2018). Physicochemical Analysis, Antioxidant and Anti Proliferation Activities

of Honey, Propolis and Beebread Harvested from Stingless Bee. *IOP Conference Series: Materials Science and Engineering*, *440*(1). https://doi.org/10.1088/1757-899X/440/1/012048

Iyyam Pillai, S., Palsamy, P., Subramanian, S., & Kandaswamy, M. (2010). Wound healing properties of Indian propolis studied on excision wound-induced rats. *Pharmaceutical Biology*, *48*(11), 1198–1206. https://doi.org/10.3109/13880200903578754

Izadiyan, P., & Hemmateenejad, B. (2016). Multi-response optimization of factors affecting ultrasonic assisted extraction from Iranian basil using central composite design. *Food Chemistry*, *190*, 864–870. https://doi.org/10.1016/j.foodchem.2015.06.036

Jaapar, M., Halim, M., Mispan, M., Jajuli, R., Saranum, M., Zainuddin, M., & Abd Ghani, I. (2016). The diversity and abundance of stingless bee (Hymenoptera: Meliponini) in Peninsular Malaysia. *Advances in Environmental Biology*, *10*(9), 1-8.

Jadid, N., Hidayati, D., Hartanti, S. R., Arraniry, B. A., Rachman, R. Y., & Wikanta, W. (2017). Antioxidant activities of different solvent extracts of Piper retrofractum Vahl. using DPPH assay. *AIP Conference Proceedings*, *1854*(June 2017). https://doi.org/10.1063/1.4985410

Jafari, S. F., Khadeer Ahamed, M. B., Iqbal, M. A., Al Suede, F. S. R., Khalid, S. H., Haque, R. A., Nassar, Z. D., Umar, M. I., & Abdul Majid, A. M. S. (2014). Increased aqueous solubility and proapoptotic activity of potassium koetjapate against human colorectal cancer cells. *Journal of Pharmacy and Pharmacology*, *66*(10), 1394–1409. https://doi.org/10.1111/jphp.12272

Jang, M., Sheu, S., Wang, C., Yeh, Y., & Sung, K. (2009). Optimization Analysis of the Experimental Parameters on the Extraction Process of Propolis. *Lecture Notes in Engineering and Computer Science*, *2175*(1), 1295–1299.

Jang, S., Lee, A. Y., Lee, A. R., Choi, G., & Kim, H. K. (2017). Optimization of ultrasound-assisted extraction of glycyrrhizic acid from licorice using response surface methodology. *Integrative Medicine Research*, *6*(4), 388–394. https://doi.org/10.1016/j.imr.2017.08.003

Janković, S., Mitić, M., Arsić, B., & Stankov-Jovanović, V. (2021). The kinetic and thermodynamic studies of solid-liquid extraction of apigenin-glycosides from parsley (Petroselinum crispum). *Separation Science and Technology (Philadelphia)*, *56*(13), 2253–2265. https://doi.org/10.1080/01496395.2020.1821219

Jiménez-Moreno, N., Volpe, F., Moler, J. A., Esparza, I., & Ancín-Azpilicueta, C. (2019). Impact of extraction conditions on the phenolic composition and antioxidant capacity of grape stem extracts. *Antioxidants*, *8*(12). https://doi.org/10.3390/antiox8120597

Jin, X. L., Wang, K., Li, Q. Q., Tian, W. L., Xue, X. F., Wu, L. M., & Hu, F. L. (2017a). Antioxidant and anti-inflammatory effects of Chinese propolis during palmitic acid-induced lipotoxicity in cultured hepatocytes. *Journal of Functional Foods*, *34*, 216–223. https://doi.org/10.1016/j.jff.2017.04.039

Jin, X. L., Wang, K., Li, Q. Q., Tian, W. L., Xue, X. F., Wu, L. M., & Hu, F. L. (2017b). Antioxidant and anti-inflammatory effects of Chinese propolis during palmitic acid-induced lipotoxicity in cultured hepatocytes. *Journal of Functional Foods*, *34*, 216–223. https://doi.org/10.1016/j.jff.2017.04.039

Jourjine, I. A. P., Zeisel, L., Krauß, J., & Bracher, F. (2021). Synthesis of highly substituted fluorenones via metal-free TBHP-promoted oxidative cyclization of 2-(aminomethyl)biphenyls. Application to the total synthesis of nobilone. *Beilstein Journal of Organic Chemistry*, *17*, 2668–2679. https://doi.org/10.3762/bjoc.17.181

Kalogeropoulos, N., Konteles, S. J., Troullidou, E., Mourtzinos, I., & Karathanos, V. T. (2009). Chemical composition, antioxidant activity and antimicrobial properties of propolis extracts from Greece and Cyprus. *Food Chemistry*, *116*(2), 452–461. https://doi.org/10.1016/j.foodchem.2009.02.060

Kandananond, K. (2010). Using the response surface method to optimize the turning process of AISI 12L14 steel. *Advances in Mechanical Engineering*, *2010*(Ccd). https://doi.org/10.1155/2010/362406

Kaneda, M., Itaka, Y., & Shibata, S. (1973). The crystal and molecular structure of cannabidiol. *Acta Chem. Scand.*, *B31*(9), 807–812. https://doi.org/10.3891/acta.chem.scand.31b-0807

Kapare, H., Lohidasan, S., Sinnathambi, A., & Mahadik, K. (2019). Standardization, anti-carcinogenic potential and biosafety of Indian propolis. *Journal of Ayurveda and Integrative Medicine*, *10*(2), 81–87. https://doi.org/10.1016/j.jaim.2017.06.003

Karacabey, E., & Mazza, G. (2010). Optimisation of antioxidant activity of grape cane extracts using response surface methodology. *Food Chemistry*, *119*(1), 343–348. https://doi.org/10.1016/j.foodchem.2009.06.029

Kartal, M., Yildiz, S., Kaya, S., Kurucu, S., & Topçu, G. (2003). Antimicrobial activity of propolis samples from two different regions of Anatolia. *Journal of Ethnopharmacology*, *86*(1), 69–73. https://doi.org/10.1016/S0378-8741(03)00042-4

Kasote, D. M., Pawar, M. V., Bhatia, R. S., Nandre, V. S., Gundu, S. S., Jagtap, S. D., & Kulkarni, M. V. (2017). HPLC, NMR based chemical profiling and biological characterisation of Indian propolis. *Fitoterapia*, *122*(August), 52–60. https://doi.org/10.1016/j.fitote.2017.08.011

Kasuya, A., & Tokura, Y. (2014). Attempts to accelerate wound healing. *Journal of Dermatological Science*, *76*(3), 169–172. https://doi.org/10.1016/j.jdermsci.2014.11.001

Kedare, S. B., & Singh, R. P. (2011). Genesis and development of DPPH method of antioxidant assay. *Journal of Food Science and Technology*, *48*(4), 412–422. https://doi.org/10.1007/s13197-011-0251-1

Kehr, J. (2006). Phloem sap proteins: Their identities and potential roles in the interaction between plants and phloem-feeding insects. *Journal of Experimental Botany*, *57*(4), 767–774. https://doi.org/10.1093/jxb/erj087

Kershaw, J., & Kim, K. H. (2017). The Therapeutic Potential of Piceatannol, a Natural Stilbene, in Metabolic Diseases: A Review. *Journal of Medicinal Food*, *20*(5), 427–438. https://doi.org/10.1089/jmf.2017.3916

Khemakhem, I., Ahmad-Qasem, M. H., Catalán, E. B., Micol, V., García-Pérez, J. V., Ayadi, M. A., & Bouaziz, M. (2017). Kinetic improvement of olive leaves' bioactive compounds extraction by using power ultrasound in a wide temperature range. *Ultrasonics Sonochemistry*, *34*, 466–473. https://doi.org/10.1016/j.ultsonch.2016.06.010

Khezeli, T., Ghaedi, M., Bahrani, S., & Daneshfar, A. (2020). Supercritical fluid extraction in separation and preconcentration of organic and inorganic species. In *New Generation Green Solvents for Separation and Preconcentration of Organic and Inorganic Species*. INC. https://doi.org/10.1016/B978-0-12-818569-8.00010-3

Killiny, N. (2019). Collection of the phloem sap, pros and cons. *Plant Signaling and Behavior*, *14*(8), 1–3. https://doi.org/10.1080/15592324.2019.1618181

Kim, C. H., Kim, M. Y., Lee, S.-W., & Jang, K.-S. (2019). UPLC/FT-ICR MS-based high-resolution platform for determining the geographical origins of raw propolis samples. *Journal of Analytical Science and Technology*, *10*(1). https://doi.org/10.1186/s40543-019-0168-2

Knez, Ž., Škerget, M., & KnezHrnčič, M. (2010). Principles of supercritical fluid extraction and applications in the food, beverage and nutraceutical industries. *Separation, Extraction and Concentration Processes in the Food, Beverage and Nutraceutical Industries*, 3–38. https://doi.org/10.1533/9780857090751.1.3

Ko, H. H., Chiang, Y. C., Tsai, M. H., Liang, C. J., Hsu, L. F., Li, S. Y., Wang, M. C., Yen, F. L., & Lee, C. W. (2014). Eupafolin, a skin whitening flavonoid isolated from Phyla nodiflora, downregulated melanogenesis: Role of MAPK and Akt pathways. *Journal of Ethnopharmacology*, *151*(1), 386–393. https://doi.org/10.1016/j.jep.2013.10.054

Krishnan, H. B., Natarajan, S. S., Bennett, J. O., & Sicher, R. C. (2011). Protein and metabolite composition of xylem sap from field-grown soybeans (Glycine max). *Planta*, *233*(5), 921–931. https://doi.org/10.1007/s00425-011-1352-9

Krithika, S., Sadiq, M., Munuswamy Ramanujam, G., & Maruthapillai, A. (2021). Trimethoxy flavone, pachypodol containing pogostemon cablin leaf extract shows broad spectrum antimicrobial activity. *Materials Today: Proceedings*, *xxxx*, 5–8. https://doi.org/10.1016/j.matpr.2021.07.136

Kubiliene, L., Jekabsone, A., Zilius, M., Trumbeckaite, S., Simanaviciute, D., Gerbutaviciene, R., & Majiene, D. (2018). Comparison of aqueous, polyethylene glycol-aqueous and ethanolic propolis extracts: Antioxidant and mitochondria modulating properties. *BMC Complementary and Alternative Medicine*, *18*(1), 1–10. https://doi.org/10.1186/s12906-018-2234-5

Kumari, K. (2020). *Kuwanons , Promising inhibitors against the ACE-2 , main protease of SARS-CoV-2 and falcipan-2 using molecular docking*. 1–15.

Kurek-Górecka, A. M., Sobczak, A., Rzepecka-Stojko, A., Górecki, M. T., Wardas, M., & Pawłowska-Góral, K. (2012). Antioxidant activity of ethanolic fractions of Polish propolis. *Zeitschrift Fur Naturforschung - Section C Journal of Biosciences*, *67 C*(11–12), 545–550. https://doi.org/10.1515/znc-2012-11-1203

Kuropatnicki, A. K., Szliszka, E., & Krol, W. (2013). Historical aspects of propolis research in modern times. *Evidence-Based Complementary and Alternative Medicine*, *2013*(April). https://doi.org/10.1155/2013/964149

Kustiawan, P. M., Puthong, S., Arung, E. T., & Chanchao, C. (2014). In vitro cytotoxicity of Indonesian stingless bee products against human cancer cell lines. *Asian Pacific Journal of Tropical Biomedicine*, *4*(7), 549–556. https://doi.org/10.12980/APJTB.4.2014APJTB-2013-0039

Kwon, Y. I. I., Vattem, D. A., & Shetty, K. (2006). Evaluation of clonal herbs of Lamiaceae species for management of diabetes and hypertension. *Asia Pacific Journal of Clinical Nutrition*, *15*(1), 107–118.

Lagouri, V., Prasianaki, D., & Krysta, F. (2014). Antioxidant properties and phenolic composition of greek propolis extracts. *International Journal of Food Properties*, *17*(3), 511–522. https://doi.org/10.1080/10942912.2012.654561

Lamuela-Raventós, R. M., Vallverdú-Queralt, A., Jáuregui, O., Martínez-Huélamo, M., & Quifer-Rada, P. (2014). Improved Characterization of Polyphenols Using Liquid Chromatography. In *Polyphenols in Plants: Isolation, Purification and Extract Preparation*. Elsevier. https://doi.org/10.1016/B978-0-12-397934-6.00014-0

Lao, R. C., Shu, Y. Y., Holmes, J., Lanoy, M., Chiu, C. H., Turle, R., B'langer, J. M. R., & Pre, J. R. J. (1996). Air sample cleaning and extraction procedures by microwave-assisted process (MAP_) technology. *Proceedings of the Air & Waste Management Association's Annual Meeting & Exhibition*, *108*, 99–108.

Lavinas, F. C., Macedo, E. H. B. C., Sá, G. B. L., Amaral, A. C. F., Silva, J. R. A., Azevedo, M. M. B., Vieira, B. A., Domingos, T. F. S., Vermelho, A. B., Carneiro, C. S., & Rodrigues, I. A. (2019). Brazilian stingless bee propolis and geopropolis: promising sources of biologically active compounds. *Revista Brasileira de Farmacognosia*, *29*(3), 389–399. https://doi.org/10.1016/j.bjp.2018.11.007

Lazar, L., Talmaciu, A. I., Volf, I., & Popa, V. I. (2016). Kinetic modeling of the ultrasound-assisted extraction of polyphenols from Picea abies bark. *Ultrasonics Sonochemistry*, *32*, 191–197. https://doi.org/10.1016/j.ultsonch.2016.03.009

Legay, M., Gondrexon, N., Le Person, S., Boldo, P., & Bontemps, A. (2011). Enhancement of heat transfer by ultrasound: Review and recent advances. *International Journal of Chemical Engineering*, *2011*. https://doi.org/10.1155/2011/670108

Li, C. C., Wang, T. L., Zhang, Z. Q., Yang, W. Q., Wang, Y. F., Chai, X., Wang, C. H., & Zheng, L. (2016). Phytochemical and pharmacological studies on the genus Proralea: A mini review. *Arabian Journal of Chemistry*, *14*(10). https://doi.org/10.1016/j.arabjc.2021.103346

Li, J., Lin, Y., He, L., Ou, R., Chen, T., Zhang, X., Li, Q., Zeng, Z., & Long, Q. (2021). Two new isoprenoid flavonoids from sophora flavescens with antioxidant and cytotoxic activities. *Molecules*, *26*(23), 1–12. https://doi.org/10.3390/molecules26237228

Li, S., Ma, H., Guo, Y., Oladejo, A. O., Yang, X., Liang, Q., & Duan, Y. (2018). A new kinetic model of ultrasound-assisted pretreatment on rice protein. *Ultrasonics Sonochemistry*, *40*(July 2017), 644–650. https://doi.org/10.1016/j.ultsonch.2017.07.010

Li, Y., Wang, C. L., Wang, Y. J., Wang, F. F., Guo, S. X., Yang, J. S., & Xiao, P. G. (2009). Four new bibenzyl derivatives from Dendrobium candidum. *Chemical and Pharmaceutical Bulletin*, *57*(9), 997–999. https://doi.org/10.1248/cpb.57.997

Li, Z., Ryenchindorj, L., Liu, B., Shi, J., Zhang, C., Hua, Y., Liu, P., Shan, G., & Jia, T. (2021). Chemical profiles and metabolite study of raw and processed Cistanche deserticola in rats by UPLC-Q-TOF-MSE. *Chinese Medicine (United Kingdom)*, *16*(1), 1–24. https://doi.org/10.1186/s13020-021-00508-0

Liang, N., & Kitts, D. D. (2014). Antioxidant property of coffee components: Assessment of methods that define mechanism of action. *Molecules*, *19*(11), 19180–19208. https://doi.org/10.3390/molecules191119180

Liao, L. X., Wang, J. K., Wan, Y. J., Liu, Y., Dong, X., Tu, P. F., & Zeng, K. W. (2020). Protosappanin A Maintains Neuronal Mitochondrial Homeostasis through Promoting Autophagic Degradation of Bax. *ACS Chemical Neuroscience*, *11*(24), 4223–4230. https://doi.org/10.1021/acschemneuro.0c00488

Libro, R., Giacoppo, S., Rajan, T. S., Bramanti, P., & Mazzon, E. (2016). Natural phytochemicals in the treatment and prevention of dementia: An overview. *Molecules*, *21*(4). https://doi.org/10.3390/molecules21040518

Lima Cavendish, R., De Souza Santos, J., Belo Neto, R., Oliveira Paixão, A., Valéria Oliveira, J., Divino De Araujo, E., Berretta E Silva, A. A., Maria Thomazzi, S., Cordeiro Cardoso, J., & Zanardo Gomes, M. (2015). Antinociceptive and anti-inflammatory effects of Brazilian red propolis extract and formononetin in rodents. *Journal of Ethnopharmacology*, *173*, 127–133. https://doi.org/10.1016/j.jep.2015.07.022

Liu, M., & Hu, W. (2010). Highly Efficient Microwave-Assisted and Ultrasonic-Assisted Extraction. *Scientific Research*, 98–101.

Llompart, M., Garcia-Jares, C., Celeiro, M., & Dagnac, T. (2019). Extraction | Microwave-Assisted Extraction. In *Encyclopedia of Analytical Science* (3rd ed., Issue June). Elsevier Inc. https://doi.org/10.1016/B978-0-12-409547-2.14442-7

Lopez-Avila, V., & Luque de Castro, M. D. (2014). Microwave-Assisted Extraction. In *Reference Module in Chemistry, Molecular Sciences and Chemical Engineering*. Elsevier Inc. https://doi.org/10.1016/b978-0-12-409547-2.11172-2

Lopez, B. G. C., de Lourenço, C. C., Alves, D. A., Machado, D., Lancellotti, M., & Sawaya, A. C. H. F. (2015). Antimicrobial and cytotoxic activity of red propolis: An alert for its safe use. *Journal of Applied Microbiology*, *119*(3), 677–687. https://doi.org/10.1111/jam.12874

Lv, L., Chen, H., Soroka, D., Chen, X., Leung, T., & Sang, S. (2012). 6-Gingerdiols As the Major Metabolites of 6-Gingerol in Cancer Cells and in Mice and Their Cytotoxic Effects on Human Cancer Cells. *Journal of Agricultural and Food Chemistry*, *60*(45), 11372–11377. https://doi.org/10.1021/jf303879b

Mæhre, H. K., Dalheim, L., Edvinsen, G. K., Elvevoll, E. O., & Jensen, I. J. (2018). Protein determination—method matters. *Foods*, *7*(1). https://doi.org/10.3390/foods7010005

Manach, C., Scalbert, A., Morand, C., Rémésy, C., & Jiménez, L. (2004). Polyphenols: Food sources and bioavailability. *American Journal of Clinical Nutrition*, *79*(5), 727–747. https://doi.org/10.1093/ajcn/79.5.727

Mangiring, G. A., Pratami, D. K., Hermansyah, H., Wijanarko, A., Rohmatin, E., & Sahlan, M. (2018). Microencapsulation of ethanol extract propolis by maltodextrin and freeze-dried preparation. *AIP Conference Proceedings*, *1933*(February 2018). https://doi.org/10.1063/1.5023946

Manzocco, L., Calligaris, S., Mastrocola, D., Nicoli, M. C., & Lerici, C. R. (2000). Review of non-enzymatic browning and antioxidant capacity in processed foods. *Trends in Food Science and Technology*, *11*(9–10), 340–346. https://doi.org/10.1016/S0924-2244(01)00014-0

Maraschin, M., Somensi-Zeggio, A., Oliveira, S. K., Kuhnen, S., Tomazzoli, M. M., Raguzzoni, J. C., Zeri, A. C. M., Carreira, R., Correia, S., Costa, C., & Rocha, M. (2016). Metabolic Profiling and Classification of Propolis Samples from Southern Brazil: An NMR-Based Platform Coupled with Machine Learning. *Journal of Natural Products*, *79*(1), 13–23. https://doi.org/10.1021/acs.jnatprod.5b00315

Maria Susana, Hernandez Zarate Abraham Juarez, M. del R., Ceron Garcia, A., Ozuna Lopez, C., Gutierrez Chavez, A. J., Segoviano Garfias, J. de J. N., & Avila Ramos, F. (2018). *Flavonoids , phenolic content , and antioxidant activity of propolis from various areas of Guanajuato , Mexico*. *2061*(June), 210–215.

Marini, H., Polito, F., Adamo, E. B., Bitto, A., Squadrito, F., & Benvenga, S. (2012). Update on genistein and thyroid: An overall message of safety. *Frontiers in Endocrinology*, *3*(JUL), 94–97. https://doi.org/10.3389/fendo.2012.00094

Martinotti, S., & Ranzato, E. (2015). Propolis: a new frontier for wound healing? *Burns & Trauma*, *3*(1), 1–7. https://doi.org/10.1186/s41038-015-0010-z

Mathiarasi, R., & Partha, N. (2016). Optimization, kinetics and thermodynamic studies on oil extraction from Daturametel Linn oil seed for biodiesel production. *Renewable Energy*, *96*, 583–590. https://doi.org/10.1016/j.renene.2016.04.078

Meneghelli, C., Joaquim, L. S. D., Félix, G. L. Q., Somensi, A., Tomazzoli, M., da Silva, D. A., Berti, F. V., Veleirinho, M. B. R., Recouvreux, D. de O. S., de Mattos Zeri, A. C., Dias, P. F., & Maraschin, M. (2013). Southern Brazilian autumnal propolis shows anti-angiogenic activity: An in vitro and in vivo study. *Microvascular Research*, *88*, 1–11. https://doi.org/10.1016/j.mvr.2013.03.003

Mgoma, S. T., Basitere, M., & Mshayisa, V. V. (2021). Kinetics and thermodynamics of oil extraction from South African hass avocados using hexane as a solvent. *South African Journal of Chemical Engineering*, *37*, 244–251. https://doi.org/10.1016/j.sajce.2021.06.007

Miean, K. H., & Mohamed, S. (2001). *Apigenin) Content of Edible Tropical Plants*. 3106–3112.

Miguel, M. G., Nunes, S., Dandlen, S. A., Cavaco, A. M., & Antunes, M. D. (2014). Phenols, flavonoids and antioxidant activity of aqueous and methanolic extracts of propolis (Apis mellifera L.) from Algarve, South Portugal. *Food Science and Technology*, *34*(1), 16–23. https://doi.org/10.1590/S0101-20612014000100002

Milić, P. S., Rajković, K. M., Stamenković, O. S., & Veljković, V. B. (2013). Kinetic modeling and optimization of maceration and ultrasound-extraction of resinoid from the aerial parts of white lady's bedstraw (Galium mollugo L.). *Ultrasonics Sonochemistry*, *20*(1), 525–534. https://doi.org/10.1016/j.ultsonch.2012.07.017

Mitic, M., Jankovic, S., Mitic, S., Kocic, G., Maskovic, P., & Dukic, D. (2021). Optimization and kinetic modelling of total phenols and flavonoids extraction from tilia cordata m. flowers. *South African Journal of Chemistry*, *75*(1), 64–72. https://doi.org/10.17159/0379-4350/2021/v75a7

Mittraphab, A., Muangnoi, C., Likhitwitayawuid, K., Rojsitthisak, P., & Sritularak, B. (2016). A new bibenzyl-phenanthrene derivative from Dendrobium signatum and its cytotoxic activity. *Natural Product Communications*, *11*(5), 657–659. https://doi.org/10.1177/1934578x1601100526

Mohadjerani, M., Hosseinzadeh, R., & Hosseini, M. (2016). *Chemical composition and antibacterial properties of essential oil and fatty acids of different parts of Ligularia persica Boiss*. *6*(3), 357–365.

Mohammadzadeh, S., Sharriatpanahi, M., Hamedi, M., Amanzadeh, Y., Sadat Ebrahimi, S. E., & Ostad, S. N. (2007). Antioxidant power of Iranian propolis extract. *Food Chemistry*, *103*(3), 729–733. https://doi.org/10.1016/j.foodchem.2006.09.014

Mohammedelnour, A., Mirgani, M., & Khalid, H. (2017). *Effect of solvent types on phenolics content and antioxidant activities of Acacia polyacantha gum*. *24*(December), 369–377.

Molaveisi, M., Beigbabaei, A., Akbari, E., Noghabi, M. S., & Mohamadi, M. (2019). Kinetics of temperature effect on antioxidant activity, phenolic compounds and color of Iranian jujube honey. *Heliyon*, *5*(1). https://doi.org/10.1016/j.heliyon.2019.e01129

Moldoveanu, & David. (2002). *Sample Extraction*. 287–339.

Mosca, F., Hidalgo, G. I., Villasante, J., & Almajano, M. P. (2018). Continuous or batch solid-liquid extraction of antioxidant compounds from seeds of Sterculia apetala plant and kinetic release study. *Molecules*, *23*(7). https://doi.org/10.3390/molecules23071759

Mottaghipisheh, J., & Stuppner, H. (2021). A comprehensive review on chemotaxonomic and phytochemical aspects of homoisoflavonoids, as rare flavonoid derivatives. *International Journal of Molecular Sciences*, *22*(5), 1–20. https://doi.org/10.3390/ijms22052735

Mouhoubi-Tafinine, Z., Ouchemoukh, S., & Tamendjari, A. (2016). Antioxydant activity of some algerian honey and propolis. *Industrial Crops and Products*, *88*, 85–90. https://doi.org/10.1016/j.indcrop.2016.02.033

Müller, L., Fröhlich, K., & Böhm, V. (2011). Comparative antioxidant activities of carotenoids measured by ferric reducing antioxidant power (FRAP), ABTS bleaching assay (αTEAC), DPPH assay and peroxyl radical scavenging assay. *Food Chemistry*, *129*(1), 139–148. https://doi.org/10.1016/j.foodchem.2011.04.045

Mulyati, A. H., Sulaeman, A., Marliyati, S. A., Rafi, M., & Rokhmah, U. F. (2021). Macro and Micronutrient Content of Raw Propolis Collected from Different Regions in Indonesia. *Jurnal Gizi Dan Pangan*, *16*(1), 109–114.

Naidu, M., Kuan, C. Y. K., Lo, W. L., Raza, M., Tolkovsky, A., Mak, N. K., Wong, R. N. S., & Keynes, R. (2007). Analysis of the action of euxanthone, a plant-derived compound that stimulates neurite outgrowth. *Neuroscience*, *148*(4), 915–924. https://doi.org/10.1016/j.neuroscience.2007.07.037

Nascentes, C. C., Korn, M., Sousa, C. S., & Arruda, M. A. Z. (2001). Use of Ultrasonic Baths for Analytical Applications: A New Approach for Optimisation Conditions. *Journal of the Brazilian Chemical Society*, *12*(1), 57–63. https://doi.org/10.1590/S0103-50532001000100008

Nenadis, N., Wang, L. F., Tsimidou, M., & Zhang, H. Y. (2004). Estimation of scavenging activity of phenolic compounds using the ABTS .+ assay. *Journal of Agricultural and Food Chemistry*, *52*(15), 4669–4674. https://doi.org/10.1021/jf0400056

Neuman, M. G., Haber, J. A., Malkiewicz, I. M., Cameron, R. G., Katz, G. G., & Shear, N. H. (2002). Ethanol signals for apoptosis in cultured skin cells. *Alcohol*, *26*(3), 179–190. https://doi.org/10.1016/S0741-8329(02)00198-2

Ngo, T. Van, Scarlett, C. J., Bowyer, M. C., Ngo, P. D., & Vuong, Q. Van. (2017). Impact of different extraction solvents on bioactive compounds and antioxidant capacity

from the root of Salacia chinensis L. *Journal of Food Quality*, *2017*. https://doi.org/10.1155/2017/9305047

Nguyen, N. V. T., Duong, N. T., Nguyen, K. N. H., Bui, N. T., Pham, T. L. T., Nguyen, K. T., Le, P. H., & Kim, K. H. (2022). Effect of extraction solvent on total phenol, flavonoid content, and antioxidant activity of avicennia officinalis. *Biointerface Research in Applied Chemistry*, *12*(2), 2678–2690. https://doi.org/10.33263/BRIAC122.26782690

Nguyen, V. S., Dong, L. P., Wang, S. C., & Wang, Q. (2015). The first total synthesis of sophoflavescenol, flavenochromane C, and citrusinol. *European Journal of Organic Chemistry*, *2015*(10), 2297–2302. https://doi.org/10.1002/ejoc.201403689

Okhale, S. E., Nkwegu, C., Ugbabe, G. E., Ibrahim, J. A., Egharevba, H. O., Kunle, O. F., & Igoli, J. O. (2021). Bee propolis: Production optimization and applications in Nigeria. *Journal of Pharmacognosy and Phytotherapy*, *13*(1), 33–45. https://doi.org/10.5897/jpp2019.0561

Okuda, T., & Seno, K. (1978). Mallotusinic acid and mallotinic acid, new hydrolyzable tannins from mallotus japonicus. *Tetrahedron Letters*, *19*(2), 139–142. https://doi.org/10.1016/S0040-4039(01)85066-8

Okuda, T., Yoshida, T., Ashida, M., & Yazaki, K. (1982). Casuarin, stachyurin and strictinin, new ellagitannins from Casuarina stricta and Stachyurus praecox. *Chemical Pharmaceutical Bulletin*, *57*(534), 364–370. http://www.mendeley.com/research/geology-volcanic-history-eruptive-style-yakedake-volcano-group-central-japan/

Oldoni, T. L. C., Oliveira, S. C., Andolfatto, S., Karling, M., Calegari, M. A., Sado, R. Y., Maia, F. M. C., Alencar, S. M., & Lima, V. A. (2015). Chemical characterization and optimization of the extraction process of bioactive compounds from propolis produced by selected bees Apis mellifera. *Journal of the Brazilian Chemical Society*, *26*(10), 2054–2062. https://doi.org/10.5935/0103-5053.20150186

Oliveira, R. N., Mancini, M. C., de Oliveira, F. C. S., Passos, T. M., Quilty, B., Thiré, R. M. da S. M., & McGuinness, G. B. (2016). Análise por FTIR e quantificação de fenóis e flavonóides de cinco produtos naturais disponíveis comercialmente utilizados no tratamento de feridas. *Revista Materia*, *21*(3), 767–779. https://doi.org/10.1590/S1517-707620160003.0072

Omar, S., Mat Kamir, N. F., & Sanny, M. (2019). *Antibacterial Activity of Malaysian Produced Stingless Bee Honey on Wound Pathogens*. *14*(3), 67–79.

Oroian, M., Ursachi, F., & Dranca, F. (2020). Influence of ultrasonic amplitude, temperature, time and solvent concentration on bioactive compounds extraction from propolis. *Ultrasonics Sonochemistry*, *64*(January), 105021. https://doi.org/10.1016/j.ultsonch.2020.105021

Osés, S. M., Marcos, P., Azofra, P., de Pabl, A., Fernández-Muíño, M. Á., & Sancho, M. T. (2020). Phenolic profile, antioxidant capacities and enzymatic inhibitory activities of propolis from different geographical areas: Needs for analytical harmonization. *Antioxidants*, *9*(1), 20–35. https://doi.org/10.3390/antiox9010075

Papotti, G., Bertelli, D., Bortolotti, L., & Plessi, M. (2012). Chemical and functional characterization of Italian propolis obtained by different harvesting methods. *Journal of Agricultural and Food Chemistry*, *60*(11), 2852–2862. https://doi.org/10.1021/jf205179d

Park, M. H., Lee, S. M., Ko, S. K., Oh, K. Y., Kim, J. H., Kim, H., Kwon, M. C., Ryoo, I. J., Ahn, J. S., Ryu, H. W., & Oh, S. R. (2018). Analysis of active metabolites of sophora flavescens for indoleamine 2,3-dioxygenase and monoamine oxidases using ultra-performance liquid chromatography-quadrupole time-of-flight mass spectrometry. *Natural Product Communications*, *13*(12), 1649–1653. https://doi.org/10.1177/1934578x1801301220

Park, Y. K., & Ikegaki, M. (1998). Preparation of water and ethanolic extracts of propolis and evaluation of the preparations. *Bioscience, Biotechnology and Biochemistry*, *62*(11), 2230–2232. https://doi.org/10.1271/bbb.62.2230

Patil, P. D., Nagula, K. N., & Tiwari, M. S. (2020). Sonochemical protocol for biocatalysis. In *Green Sustainable Process for Chemical and Environmental Engineering and Science: Sonochemical Organic Synthesis*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-819540-6.00006-1

Patrulea, V., Ostafe, V., Borchard, G., & Jordan, O. (2015). Chitosan as a starting material for wound healing applications. *European Journal of Pharmaceutics and Biopharmaceutics*, *97*, 417–426. https://doi.org/10.1016/j.ejpb.2015.08.004

Paunovic, D., Mitic, S., Kostic, D., Mitic, M., Stojanovic, B., & Pavlovic, J. (2014). Kinetics and thermodynamics of the solid-liquid extraction process of total polyphenols from barley. *Savremene Tehnologije*, *3*(2), 58–63. https://doi.org/10.5937/savteh1402058p

Paunović, D., Mitić, S. S., Stojanović, G. S., Mitić, M. N., Stojanović, B. T., & Stojković, M. B. (2015). Kinetics of the Solid-Liquid Extraction Process of Phenolic Antioxidants and Antioxidant Capacity from Hop (Humulus lupulus L.). *Separation Science and Technology (Philadelphia)*, *50*(11), 1658–1664. https://doi.org/10.1080/01496395.2014.978019

Paviani, L. C., Fiorito, G., Sacoda, P., & Cabral, F. A. (2013). Different Solvents for Extraction of Brazilian Green Propolis : Composition and Extraction Yield of Phenolic Compounds. *III Iberoamerican Conference on Supercritial Fluids*, 1–7.

Paviani, L. C., Saito, E., Dariva, C., Marcucci, M. C., Sánchez-Camargo, A. P., & Cabral, F. A. (2012). Supercritical CO 2 extraction of raw propolis and its dry ethanolic extract. *Brazilian Journal of Chemical Engineering*, *29*(2), 243–251. https://doi.org/10.1590/S0104-66322012000200005

Pękal, A., & Pyrzynska, K. (2014). Evaluation of Aluminium Complexation Reaction for Flavonoid Content Assay. *Food Analytical Methods*, *7*(9), 1776–1782. https://doi.org/10.1007/s12161-014-9814-x

Pellati, F., Prencipe, F. P., Bertelli, D., & Benvenuti, S. (2013). An efficient chemical analysis of phenolic acids and flavonoids in raw propolis by microwave-assisted extraction combined with high-performance liquid chromatography using the fused-core technology. *Journal of Pharmaceutical and Biomedical Analysis*, *81–82*, 126–132. https://doi.org/10.1016/j.jpba.2013.04.003

Pessolato, A. G. T., Martins, D. D. S., Ambrósio, C. E., Manançares, C. A. F., & De Carvalho, A. F. (2011). Propolis and amnion reepithelialise second-degree burns in rats. *Burns*, *37*(7), 1192–1201. https://doi.org/10.1016/j.burns.2011.05.016

Phelps, C. L., Smart, N. G., & Wai, C. M. (1996). Past, present, and possible future applications of supercritical fluid extraction technology. *Journal of Chemical Education*, *73*(12), 1163–1168. https://doi.org/10.1021/ed073p1163

Pinchao-Pinchao, Y. A., Ordoñez-Santos, L. E., & Osorio-Mora, O. (2019). Evaluation of the effect of different factors on the ultrasound assisted extraction of phenolic compounds of the pea pod. *DYNA (Colombia)*, *86*(210), 211–215. https://doi.org/10.15446/dyna.v86n210.72880

Popova, M., Silici, S., Kaftanoglu, O., & Bankova, V. (2005). Antibacterial activity of Turkish propolis and its qualitative and quantitative chemical composition. *Phytomedicine*, *12*(3), 221–228. https://doi.org/10.1016/j.phymed.2003.09.007

Potipiranun, T., Adisakwattana, S., Worawalai, W., Ramadhan, R., & Phuwapraisirisan, P. (2018). Identification of Pinocembrin as an Anti-Glycation Agent and α-Glucosidase Inhibitor from Fingerroot (Boesenbergia rotunda): The tentative structure–activity relationship towards Mg-trapping activity. *Molecules*, *23*(12), 1–13. https://doi.org/10.3390/molecules23123365

Pratami, D. K., Mun'im, A., Sundowo, A., & Sahlan, M. (2018). Phytochemical profile and antioxidant activity of propolis ethanolic extract from tetragonula bee. *Pharmacognosy Journal*, *10*(1), 128–135. https://doi.org/10.5530/pj.2018.1.23

Rahman, N., Rahman, H., Haris, M., & Mahmood, R. (2017). Wound healing potentials of Thevetia peruviana: Antioxidants and inflammatory markers criteria. *Journal of Traditional and Complementary Medicine*, *7*(4), 519–525. https://doi.org/10.1016/j.jtcme.2017.01.005

Rakhee, Mishra, J., Sharma, R. K., & Misra, K. (2018). Characterization Techniques for Herbal Products. In *Management of High Altitude Pathophysiology*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-813999-8.00009-4

Ramadan, A., Soliman, G., Mahmoud, S. S., Nofal, S. M., & Abdel-Rahman, R. F. (2012). Evaluation of the safety and antioxidant activities of Crocus sativus and Propolis ethanolic extracts. *Journal of Saudi Chemical Society*, *16*(1), 13–21. https://doi.org/10.1016/j.jscs.2010.10.012

Ramanauskiene, K., Inkeniene, A. M., Petrikaite, V., & Briedis, V. (2013). Total phenolic content and antimicrobial activity of different lithuanian propolis solutions. *Evidence-Based Complementary and Alternative Medicine*, *2013*. https://doi.org/10.1155/2013/842985

Ramawat, K. G., & Mérillon, J. M. (2013). Natural products: Phytochemistry, botany and metabolism of alkaloids, phenolics and terpenes. In *Natural Products: Phytochemistry, Botany and Metabolism of Alkaloids, Phenolics and Terpenes*. https://doi.org/10.1007/978-3-642-22144-6

Ramnath, S., & Venkataramegowda, S. (2016). Antioxidant Activity of Indian Propolis - An *In Vitro* Evaluation. *International Journal of Pharmacology, Phytochemistry and Ethnomedicine*, *5*, 79–85. https://doi.org/10.18052/www.scipress.com/ijppe.5.79

Ramos, a. F. N., & Miranda, J. L. (2007). March 19, 2007. *Review Literature And Arts Of The Americas*, *13*(4), 697–710.

Rassu, G., Cossu, M., Langasco, R., Carta, A., Cavalli, R., Giunchedi, P., & Gavini, E. (2015). Propolis as lipid bioactive nano-carrier for topical nasal drug delivery. *Colloids and Surfaces B: Biointerfaces*, *136*, 908–917. https://doi.org/10.1016/j.colsurfb.2015.10.043

Ratnavathi, C. V., & Komala, V. V. (2016). Sorghum Grain Quality. In *Sorghum Biochemistry: An Industrial Perspective*. https://doi.org/10.1016/B978-0-12-803157-5.00001-0

Rehman, M. U., Abdullah, Khan, F., & Niaz, K. (2020). Introduction to natural products analysis. In *Recent Advances in Natural Products Analysis*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-816455-6.00001-9

Reis, J. H. de O., Machado, B. A. S., Barreto, G. de A., Anjos, J. P. Dos, Fonseca, L. M. D. S., Santos, A. A. B., Pessoa, F. L. P., & Druzian, J. I. (2020). Supercritical Extraction of Red Propolis: Operational Conditions and Chemical Characterization. *Molecules (Basel, Switzerland)*, *25*(20). https://doi.org/10.3390/molecules25204816

Ren, M., Zhao, Y., He, Z., Lin, J., Xu, C., Liu, F., Hu, R., Deng, H., & Wang, Y. (2021). Baicalein inhibits inflammatory response and promotes osteogenic activity in periodontal ligament cells challenged with lipopolysaccharides. *BMC Complementary Medicine and Therapies*, *21*(1), 1–11. https://doi.org/10.1186/s12906-021-03213-5

Reuveny, S., Velez, D., Macmillan, J. D., & Miller, L. (1986). Factors affecting cell growth and monoclonal antibody production in stirred reactors. *Journal of Immunological Methods*, *86*(1), 53–59. https://doi.org/10.1016/0022-1759(86)90264-4

Revilla, I., Vivar-Quintana, A. M., González-Martín, I., Escuredo, O., & Seijo, C. (2017). The potential of near infrared spectroscopy for determining the phenolic,

antioxidant, color and bactericide characteristics of raw propolis. *Microchemical Journal*, *134*, 211–217. https://doi.org/10.1016/j.microc.2017.06.006

Rezazi, S., Abdelmalek, S., & Hanini, S. (2017). Kinetic Study and Optimization of Extraction Process Conditions. *Energy Procedia*, *139*(2015), 98–104. https://doi.org/10.1016/j.egypro.2017.11.180

Rizzolo, A., Bianchi, G., Povolo, M., Migliori, C. A., Contarini, G., Pelizzola, V., & Cattaneo, T. M. P. (2016). Volatile compound composition and antioxidant activity of cooked ham slices packed in propolis-based active packaging. *Food Packaging and Shelf Life*, *8*, 41–49. https://doi.org/10.1016/j.fpsl.2016.03.002

Rocha, B. A., Bueno, P. C. P., Vaz, M. M. D. O. L. L., Nascimento, A. P., Ferreira, N. U., Moreno, G. D. P., Rodrigues, M. R., Costa-Machado, A. R. D. M., Barizon, E. A., Campos, J. C. L., De Oliveira, P. F., Acésio, N. D. O., Martins, S. D. P. L., Tavares, D. C., & Berretta, A. A. (2013). Evaluation of a propolis water extract using a reliable RP-HPLC methodology and in vitro and in vivo efficacy and safety characterisation. *Evidence-Based Complementary and Alternative Medicine*, *2013*. https://doi.org/10.1155/2013/670451

Rodríguez De Luna, S. L., Ramírez-Garza, R. E., & Serna Saldívar, S. O. (2020). Environmentally Friendly Methods for Flavonoid Extraction from Plant Material: Impact of Their Operating Conditions on Yield and Antioxidant Properties. *Scientific World Journal*, *2020*. https://doi.org/10.1155/2020/6792069

Rojczyk, E., Klama-Baryła, A., Łabuś, W., Wilemska-Kucharzewska, K., & Kucharzewski, M. (2020). Historical and modern research on propolis and its application in wound healing and other fields of medicine and contributions by Polish studies. *Journal of Ethnopharmacology*, *262*(April). https://doi.org/10.1016/j.jep.2020.113159

Rosli, N. L., Roslan, H., Omar, E. A., Mokhtar, N., Hapit, N. H. A., & Asem, N. (2016). Phytochemical analysis and antioxidant activities of Trigona Apicalis propolis extract. *AIP Conference Proceedings*, *1791*(2016). https://doi.org/10.1063/1.4968873

Rufatto, L. C., dos Santos, D. A., Marinho, F., Henriques, J. A. P., Roesch Ely, M., & Moura, S. (2017). Red propolis: Chemical composition and pharmacological activity. *Asian Pacific Journal of Tropical Biomedicine*, *7*(7), 591–598. https://doi.org/10.1016/j.apjtb.2017.06.009

Ruhan, A., Motonobu, G., & Mitrusru, S. (2008). Supercritical Fluid Extraction in Food Analysis. In *Handbook of Food Analysis Instruments*. https://doi.org/10.1201/9781420045673.ch3

Saftić, L., Peršurić, Ž., & Kraljević Pavelić, S. (2019). LC–QQQ and LC–QTOF MS methods for comprehensive detection of potential allergens in various propolis extracts. *European Food Research and Technology*, *245*(9), 1981–1995. https://doi.org/10.1007/s00217-019-03308-x

Şahin, S., Aybastier, Ö., & Işik, E. (2013). Optimisation of ultrasonic-assisted extraction of antioxidant compounds from Artemisia absinthium using response surface methodology. *Food Chemistry*, *141*(2), 1361–1368. https://doi.org/10.1016/j.foodchem.2013.04.003

Salih, A. M., Al-Qurainy, F., Nadeem, M., Tarroum, M., Khan, S., Shaikhaldein, H. O., Al-Hashimi, A., Alfagham, A., & Alkahtani, J. (2021). Optimization method for phenolic compounds extraction from medicinal plant (Juniperus procera) and phytochemicals screening. *Molecules*, *26*(24). https://doi.org/10.3390/molecules26247454

Sambou, M., Jean-françois, J., Moutombi, F. J. N., Mathieu, P. A. H., Joy, A. P., Barnett, D. A., Surette, M. E., Boudreau, L. H., & Touaibia, M. (2020). Propolis from Eastern Canada. *Molecules*, *25(2397)*, 1–20.

Sampietro, D. A., Sampietro Vattuone, M. M., & Vattuone, M. A. (2016). Immunomodulatory activity of Apis mellifera propolis from the North of Argentina. *LWT - Food Science and Technology*, *70*, 9–15. https://doi.org/10.1016/j.lwt.2016.02.028

Sánchez-Rangel, J. C., Benavides, J., Heredia, J. B., Cisneros-Zevallos, L., & Jacobo-Velázquez, D. A. (2013). The Folin-Ciocalteu assay revisited: Improvement of its specificity for total phenolic content determination. *Analytical Methods*, *5*(21), 5990–5999. https://doi.org/10.1039/c3ay41125g

Santos-Buelga, C., Feliciano, A. S., & McPhee, D. J. (2017). Flavonoids: From structure to health issues. *Molecules*, *22*(3). https://doi.org/10.3390/molecules22030477

Santos, N. A., Cordeiro, A. M. T. M., Damasceno, S. S., Aguiar, R. T., Rosenhaim, R., Carvalho Filho, J. R., Santos, I. M. G., Maia, A. S., & Souza, A. G. (2012). Commercial antioxidants and thermal stability evaluations. *Fuel*, *97*(September 2016), 638–643. https://doi.org/10.1016/j.fuel.2012.01.074

Sasaki, K., Wada, K., & Haga, M. (2003). Chemistry and biological activities of Ginkgo biloba. *Studies in Natural Products Chemistry*, *28*, 165–198. https://doi.org/10.1016/S1572-5995(03)80141-2

Sawaya, A. C. H. F., Barbosa da Silva Cunha, I., & Marcucci, M. C. (2011). Analytical methods applied to diverse types of Brazilian propolis. *Chemistry Central Journal*, *5*(1), 1–10. https://doi.org/10.1186/1752-153X-5-27

Sehn, E., Hernandes, L., Franco, S. L., Gonçalves, C. C. M., & Baesso, M. L. (2009). Dynamics of reepithelialisation and penetration rate of a bee propolis formulation during cutaneous wounds healing. *Analytica Chimica Acta*, *635*(1), 115–120. https://doi.org/10.1016/j.aca.2009.01.019

Seo, H. J., & Surh, Y. J. (2001). Eupatilin, a pharmacologically active flavone derived from Artemisia plants, induces cell cycle arrest in ras-transformed human mammary epithelial cells. *Biochemical Pharmacology*, *68*(6), 1081–1087. https://doi.org/10.1016/j.bcp.2004.04.027

Sforcin, J. M., & Bankova, V. (2011). Propolis: Is there a potential for the development of new drugs? *Journal of Ethnopharmacology*, *133*(2), 253–260. https://doi.org/10.1016/j.jep.2010.10.032

Shamsudin, S., Selamat, J., Sanny, M., Abd. Razak, S. B., Jambari, N. N., Mian, Z., & Khatib, A. (2019). Influence of origins and bee species on physicochemical, antioxidant properties and botanical discrimination of stingless bee honey. *International Journal of Food Properties*, *22*(1), 238–263. https://doi.org/10.1080/10942912.2019.1576730

Sheng, J., Zhou, J., Wang, L., Xu, J., & Hu, Q. (2007). Antioxidant activity of ethanol and petroleum ether extracts from Brazilian propolis. *European Food Research and Technology*, *225*(2), 249–253. https://doi.org/10.1007/s00217-006-0411-0

Shewale, S., & Rathod, V. K. (2018). Extraction of total phenolic content from Azadirachta indica or (neem) leaves: Kinetics study. *Preparative Biochemistry and Biotechnology*, *48*(4), 312–320. https://doi.org/10.1080/10826068.2018.1431784

Silva-Carvalho, R., Miranda-Gonçalves, V., Ferreira, A. M., Cardoso, S. M., Sobral, A. J. F. N., Almeida-Aguiar, C., & Baltazar, F. (2014). Antitumoural and antiangiogenic activity of Portuguese propolis in in vitro and in vivo models. *Journal of Functional Foods*, *11*(C), 160–171. https://doi.org/10.1016/j.jff.2014.09.009

Silva, I. A. A. Da, Silva, T. M. S. Da, Camara, C. A., Queiroz, N., Magnani, M., Novais, J. S. De, Soledade, L. E. B., Lima, E. D. O., Souza, A. L. De, & Souza, A. G. De. (2013). Phenolic profile, antioxidant activity and palynological analysis of stingless bee honey from Amazonas, Northern Brazil. *Food Chemistry*, *141*(4), 3252–3258. https://doi.org/10.1016/j.foodchem.2013.06.072

Singh, S., Young, A., & McNaught, C. E. (2017). The physiology of wound healing. *Surgery (United Kingdom)*, *35*(9), 473–477. https://doi.org/10.1016/j.mpsur.2017.06.004

Siripatrawan, U., Vitchayakitti, W., & Sanguandeekul, R. (2013). Antioxidant and antimicrobial properties of Thai propolis extracted using ethanol aqueous solution. *International Journal of Food Science and Technology*, *48*(1), 22–27. https://doi.org/10.1111/j.1365-2621.2012.03152.x

Snitsarev, V., Young, M. N., Miller, R. M. S., & Rotella, D. P. (2013). The spectral properties of (-)-epigallocatechin 3-O-gallate (EGCG) fluorescence in different solvents: Dependence on solvent polarity. *PLoS ONE*, *8*(11), 1–6. https://doi.org/10.1371/journal.pone.0079834

Sobočanec, S., Šverko, V., Balog, T., Šarić, A., Rusak, G., Likić, S., Kušić, B., Katalinić, V., Radić, S., & Marotti, T. (2006). Oxidant/antioxidant properties of Croatian native propolis. *Journal of Agricultural and Food Chemistry*, *54*(21), 8018–8026. https://doi.org/10.1021/jf0612023

Soltani, E. K., Cerezuela, R., Charef, N., Mezaache-Aichour, S., Esteban, M. A., & Zerroug, M. M. (2017). Algerian propolis extracts: Chemical composition, bactericidal activity and in vitro effects on gilthead seabream innate immune responses. *Fish and Shellfish Immunology*, *62*, 57–67. https://doi.org/10.1016/j.fsi.2017.01.009

Sorg, H., Tilkorn, D. J., Hager, S., Hauser, J., & Mirastschijski, U. (2017). Skin Wound Healing: An Update on the Current Knowledge and Concepts. *European Surgical Research*, *58*(1–2), 81–94. https://doi.org/10.1159/000454919

Spiegel, M., Kapusta, K., Kołodziejczyk, W., Saloni, J., Zbikowska, B., Hill, G. A., & Sroka, Z. (2020). Antioxidant Activity of Selected Phenolic Acids–Ferric Reducing Antioxidant Power Assay and QSAR Analysis of the Structural Features. *Molecules*, *25*(13). https://doi.org/10.3390/molecules25133088

Spigno, G., Tramelli, L., & De Faveri, D. M. (2007). Effects of extraction time, temperature and solvent on concentration and antioxidant activity of grape marc phenolics. *Journal of Food Engineering*, *81*(1), 200–208. https://doi.org/10.1016/j.jfoodeng.2006.10.021

Stavropoulou, M. I., Stathopoulou, K., Cheilari, A., Benaki, D., Gardikis, K., Chinou, I., & Aligiannis, N. (2021). NMR metabolic profiling of Greek propolis samples: Comparative evaluation of their phytochemical compositions and investigation of their anti-ageing and antioxidant properties. *Journal of Pharmaceutical and Biomedical Analysis*, *194*, 113814. https://doi.org/10.1016/j.jpba.2020.113814

Stepanović, S., Antić, N., Dakić, I., & Švabić-Vlahović, M. (2003). In vitro antimicrobial activity of propolis and synergism between propolis and antimicrobial drugs. *Microbiological Research*, *158*(4), 353–357. https://doi.org/10.1078/0944-5013-00215

Stoica, R., Senin, R. M., & Ion, R. M. (2013). Ethanol concentration effect on the extraction of phenolic compounds from ribes nigrum assessed by spectrophotometric and HPLC-DAD methods. *Revista de Chimie*, *64*(6), 620–624.

Stompor-gorący, M., Bajek-bil, A., & Machaczka, M. (2021). Chrysin: Perspectives on contemporary status and future possibilities as pro-health agent. *Nutrients*, *13*(6). https://doi.org/10.3390/nu13062038

Subroto, E., Manurung, R., Heeres, H. J., & Broekhuis, A. A. (2015). Optimization of mechanical oil extraction from Jatropha curcas L: Kernel using response surface method. *Industrial Crops and Products*, *63*, 294–302. https://doi.org/10.1016/j.indcrop.2014.08.050

Sun, C., Wu, Z., Wang, Z., & Zhang, H. (2015). Effect of ethanol/water solvents on phenolic profiles and antioxidant properties of Beijing propolis extracts. *Evidence-Based Complementary and Alternative Medicine*, *2015*. https://doi.org/10.1155/2015/595393

Sun, P., Li, Y., Wei, S., Zhao, T., Wang, Y., Song, C., Xue, L., Wang, F., Xiao, L., Wu, J., & Qiao, M. (2018). Pharmacological Effects and Chemical Constituents of Bupleurum. *Mini-Reviews in Medicinal Chemistry*, *19*(1), 34–55. https://doi.org/10.2174/1871520618666180628155931

Sun, Y., Yang, A. W. H., & Lenon, G. B. (2020). Phytochemistry, ethnopharmacology, pharmacokinetics and toxicology of Cnidium monnieri (L.) cusson. *International Journal of Molecular Sciences*, *21*(3). https://doi.org/10.3390/ijms21031006

Svečnjak, L., Marijanović, Z., Okińczyc, P., Kuś, P. M., & Jerković, I. (2020). Mediterranean propolis from the adriatic sea islands as a source of natural antioxidants: Comprehensive chemical biodiversity determined by GC-MS, ftiratr, UHPLC-DAD-QQTOF-MS, DPPH and FRAP assay. *Antioxidants*, *9*(4). https://doi.org/10.3390/antiox9040337

Tan, P. W., Tan, C. P., & Ho, C. W. (2011). Antioxidant properties: Effects of solid-to-solvent ratio on antioxidant compounds and capacities of pegaga (Centella asiatica). *International Food Research Journal*, *18*(2), 557–562.

Tanaka, Y., Suzuki, M., Kodachi, Y., & Nihei, K. ichi. (2019). Molecular design of potent, hydrophilic tyrosinase inhibitors based on the natural dihydrooxyresveratrol skeleton. *Carbohydrate Research*, *472*(September 2018), 42–49. https://doi.org/10.1016/j.carres.2018.11.006

Tang, W., Hioki, H., Harada, K., Kubo, M., & Fukuyama, Y. (2007). Antioxidant phenylpropanoid-substituted epicatechins from Trichilia catigua. *Journal of Natural Products*, *70*(12), 2010–2013. https://doi.org/10.1021/np0703895

Teng, H., Jo, I. H., & Choi, Y. H. (2010). Optimization of ultrasonic-assisted extraction of phenolic compounds from chinese quince (Chaenomeles sinensis) by response surface methodology. *Journal of Applied Biological Chemistry*, *53*(5), 618–625. https://doi.org/10.3839/jksabc.2010.094

Tomasina, F., Carabio, C., Celano, L., & Thomson, L. (2012). Analysis of two methods to evaluate antioxidants. *Biochemistry and Molecular Biology Education*, *40*(4), 266–270. https://doi.org/10.1002/bmb.20617

Toreti, V. C., Sato, H. H., Pastore, G. M., & Park, Y. K. (2013). Recent progress of propolis for its biological and chemical compositions and its botanical origin. *Evidence-Based Complementary and Alternative Medicine*, *2013*. https://doi.org/10.1155/2013/697390

Tristantini, D., & Amalia, R. (2019). Quercetin concentration and total flavonoid content of anti-atherosclerotic herbs using aluminum chloride colorimetric assay. *AIP Conference Proceedings*, *2193*(December 2019). https://doi.org/10.1063/1.5139349

Truong, D. H., Nguyen, D. H., Ta, N. T. A., Bui, A. V., Do, T. H., & Nguyen, H. C. (2019). Evaluation of the use of different solvents for phytochemical constituents, antioxidants, and in vitro anti-inflammatory activities of severinia buxifolia. *Journal of Food Quality*, *2019*. https://doi.org/10.1155/2019/8178294

Trusheva, B., Trunkova, D., & Bankova, V. (2007). Different extraction methods of biologically active components from propolis; a preliminary study. *Chemistry Central Journal*, *1*(1), 1–4. https://doi.org/10.1186/1752-153X-1-13

Tyagi, T., & Agarwal, M. (2017). *GC-MS ANALYSIS OF INVASIVE AQUATIC WEED , PISTIA STRATIOTES L . AND EICHHORNIA CRASSIPES (MART .) SOLMS*. *9*(3).

Tyszka-Czochara, M., Paśko, P., Reczyński, W., Szlósarczyk, M., Bystrowska, B., & Opoka, W. (2014). Zinc and propolis reduces cytotoxicity and proliferation in skin fibroblast cell culture: Total polyphenol content and antioxidant capacity of propolis. *Biological Trace Element Research*, *160*(1), 123–131. https://doi.org/10.1007/s12011-014-0019-3

Ukwubile, C. A., Ahmed, A., Katsayal, U. A., Ya, J., & Mejida, S. (2019). *GC – MS analysis of bioactive compounds from Melastomastrum capitatum (Vahl) Fern . leaf methanol extract : An anticancer plant*. *3*, 10–17. https://doi.org/10.1016/j.sciaf.2019.e00059

Uma, D. B., Ho, C. W., & Wan Aida, W. M. (2010). Optimization of extraction parameters of total phenolic compounds from henna (Lawsonia inermis) leaves. *Sains Malaysiana*, *39*(1), 119–128.

Umthong, S., Phuwapraisirisan, P., Puthong, S., & Chanchao, C. (2011). In vitro antiproliferative activity of partially purified Trigona laeviceps propolis from Thailand on human cancer cell lines. *BMC Complementary and Alternative Medicine*, *11*. https://doi.org/10.1186/1472-6882-11-37

Unit, T. (2019). *Issn: 2277–4998*. *8*(10), 1851–1858.

Van Boekel, M. A. J. S. (2008). Kinetic modeling of food quality: A critical review. *Comprehensive Reviews in Food Science and Food Safety*, *7*(1), 144–158. https://doi.org/10.1111/j.1541-4337.2007.00036.x

Van Der Meer, A. D., Vermeul, K., Poot, A. A., Feijen, J., & Vermes, I. (2010). A microfluidic wound-healing assay for quantifying endothelial cell migration. *American Journal of Physiology - Heart and Circulatory Physiology*, *298*(2), 719–725. https://doi.org/10.1152/ajpheart.00933.2009

Velnar, T., Bailey, T., & Smrkolj, V. (2009). The wound healing process: An overview of the cellular and molecular mechanisms. *Journal of International Medical Research*, *37*(5), 1528–1542. https://doi.org/10.1177/147323000903700531

Venkatesan, T., Choi, Y., & Kim, Y. (2019). *Impact of Different Extraction Solvents on Phenolic Content and Antioxidant Potential of Pinus densiflora Bark Extract*. *2019*.

Vieira, V., Prieto, M. A., Barros, L., Coutinho, J. A. P., Ferreira, O., & Ferreira, I. C. F. R. (2017). Optimization and comparison of maceration and microwave extraction systems for the production of phenolic compounds from Juglans regia L. for the valorization of walnut leaves. *Industrial Crops and Products*, *107*(May), 341–352. https://doi.org/10.1016/j.indcrop.2017.06.012

Visintini Jaime, M. F., Campos, R. H., Martino, V. S., Cavallaro, L. V., & Muschietti, L. V. (2013). Antipoliovirus activity of the organic extract of Eupatorium buniifolium: Isolation of euparin as an active compound. *Evidence-Based Complementary and Alternative Medicine*, *2013*. https://doi.org/10.1155/2013/402364

Wagh, V. D. (2013). Propolis: A wonder bees product and its pharmacological potentials. *Advances in Pharmacological Sciences*, *2013*. https://doi.org/10.1155/2013/308249

Waller, S. B., Peter, C. M., Hoffmann, J. F., Picoli, T., Osório, L. da G., Chaves, F., Zani, J. L., de Faria, R. O., de Mello, J. R. B., & Meireles, M. C. A. (2017). Chemical and cytotoxic analyses of brown Brazilian propolis (Apis mellifera) and its in vitro activity against itraconazole-resistant Sporothrix brasiliensis. *Microbial Pathogenesis*, *105*, 117–121. https://doi.org/10.1016/j.micpath.2017.02.022

Wang, D. Y., Hu, Y. Z., Kong, S. S., Yu, Y. P., Zhu, D. Y., & Lou, Y. J. (2011). Promoting effects of isobavachin on neurogenesis of mouse embryonic stem cells were associated with protein prenylation. *Acta Pharmacologica Sinica*, *32*(4), 425–432. https://doi.org/10.1038/aps.2011.5

Wang, J., Sun, B., Cao, Y., Tian, Y., & Li, X. (2008). Optimisation of ultrasound-assisted extraction of phenolic compounds from wheat bran. *Food Chemistry*, *106*(2), 804–810. https://doi.org/10.1016/j.foodchem.2007.06.062

Wang, K., Zhang, J., Ping, S., Ma, Q., Chen, X., Xuan, H., Shi, J., Zhang, C., & Hu, F. (2014). Anti-inflammatory effects of ethanol extracts of Chinese propolis and buds from poplar (Populus×canadensis). *Journal of Ethnopharmacology*, *155*(1), 300–311. https://doi.org/10.1016/j.jep.2014.05.037

Wang, L., Zhou, Y., Qin, Y., Wang, Y., Liu, B., Fang, R., & Bai, M. (2019). Methylophiopogonanone B of radix ophiopogonis protects cells from H2O2-induced apoptosis through the NADPH oxidase pathway in HUVECs. *Molecular Medicine Reports*, *20*(4), 3691–3700. https://doi.org/10.3892/mmr.2019.10625

Wang, P. H., Huang, B. S., Horng, H. C., Yeh, C. C., & Chen, Y. J. (2018). Wound healing. *Journal of the Chinese Medical Association*, *81*(2), 94–101. https://doi.org/10.1016/j.jcma.2017.11.002

Wang, S., Zhang, Q., Zhang, Y., Shen, C., Wang, Z., Wu, Q., Zhang, Y., Li, S., & Qiao, Y. (2016). Agrimol B suppresses adipogenesis through modulation of SIRT1-PPAR gamma signal pathway. *Biochemical and Biophysical Research Communications*, *477*(3), 454–460. https://doi.org/10.1016/j.bbrc.2016.06.078

Wang, T., Liu, Q., Wang, M., & Zhang, L. (2020). Metabolomics reveals discrimination of Chinese propolis from different climatic regions. *Foods*, *9*(4), 1–14. https://doi.org/10.3390/foods9040491

Wang, Y. H. (2021). Traditional Uses and Pharmacologically Active Constituents of Dendrobium Plants for Dermatological Disorders: A Review. *Natural Products*

and Bioprospecting, *11*(5), 465–487. https://doi.org/10.1007/s13659-021-00305-0

Wardhani, D. H., Sari, D. K., & Prasetyaningrum, A. (2014). Ultrasonic-Assisted Extraction of Antioxidant Phenolic Coumpounds From Eucheuma Cottonii. *Reaktor*, *14*(4). https://doi.org/10.14710/reaktor.14.4.291-297

Williams, R. J., Spencer, J. P. E., & Rice-Evans, C. (2004). Flavonoids: Antioxidants or signalling molecules? *Free Radical Biology and Medicine*, *36*(7), 838–849. https://doi.org/10.1016/j.freeradbiomed.2004.01.001

Wissam, Z., Ali, A., & Rama, H. (2016). Optimization of extraction conditions for the recovery of phenolic compounds and antioxidants from Syrian olive leaves. *Journal of Pharmacognosy and Phytochemistry The*, *5*(5), 390–394.

Wong, B. Y., Tan, C. P., & Ho, C. W. (2013). Effect of solid-to-solvent ratio on phenolic content and antioxidant capacities of "Dukung Anak" (Phyllanthus niruri). *International Food Research Journal*, *20*(1), 325–330.

Woo, S. O., Hong, I., & Han, S. (2015). Extraction Properties of Propolis with Ethanol Concentration. *Journal of Apiculture*, *30*(3), 211. https://doi.org/10.17519/apiculture.2015.09.30.3.211

Wu, M., Li, X., Wang, S., Yang, S., Zhao, R., Xing, Y., & Liu, L. (2020). Polydatin for treating atherosclerotic diseases: A functional and mechanistic overview. *Biomedicine and Pharmacotherapy*, *128*(February), 110308. https://doi.org/10.1016/j.biopha.2020.110308

Wu, X. Q., Li, W., Chen, J. X., Zhai, J. W., Xu, H. Y., Ni, L., & Wu, S. S. (2019). Chemical constituents and biological activity profiles on Pleione (Orchidaceae). *Molecules*, *24*(17). https://doi.org/10.3390/molecules24173195

Xu, F. W., Lv, Y. L., Zhong, Y. F., Xue, Y. N., Wang, Y., Zhang, L. Y., Hu, X., & Tan, W. Q. (2021). Beneficial effects of green tea EGCG on skin wound healing: A comprehensive review. *Molecules*, *26*(20), 1–16. https://doi.org/10.3390/molecules26206123

Xu, H., Zheng, Y.-W., Liu, Q., Liu, L.-P., Luo, F.-L., Zhou, H.-C., Isoda, H., Ohkohchi, N., & Li, Y.-M. (2018). Reactive Oxygen Species in Skin Repair, Regeneration, Aging, and Inflammation. *Reactive Oxygen Species (ROS) in Living Cells*. https://doi.org/10.5772/intechopen.72747

Yang, J., Chen, H., Wang, Q., Deng, S., Huang, M., Ma, X., Song, P., Du, J., Huang, Y., Wen, Y., Ren, Y., & Yang, X. (2018). Inhibitory effect of kurarinone on growth of human non-small cell lung cancer: An experimental study both in vitro and in vivo studies. *Frontiers in Pharmacology*, *9*(MAR), 1–11. https://doi.org/10.3389/fphar.2018.00252

Yang, Y., An, R., Feng, T., Qin, X., Zhang, J., Bo, Y., & Niu, B. (2019). Skullcapflavone I suppresses proliferation of human lung cancer cells via down-regulating microRNA-21. *Experimental and Molecular Pathology*, *110*, 104285. https://doi.org/10.1016/j.yexmp.2019.104285

Yang, Y., Wang, S., Bao, Y. rui, Li, T. jiao, Yang, G. lin, Chang, X., & Meng, X. sheng. (2017). Anti-ulcer effect and potential mechanism of licoflavone by regulating inflammation mediators and amino acid metabolism. *Journal of Ethnopharmacology*, *199*, 175–182. https://doi.org/10.1016/j.jep.2017.01.053

Yap, S. K., & Chin, N. L. (2020). Kinetic modeling on quality parameters of raw Kelulut honey during dehydration process. *Journal of Food Process Engineering*, *43*(6). https://doi.org/10.1111/jfpe.13392

Yeo, K. L., Leo, C. P., & Chan, D. J. C. (2015). Ultrasonic Enhancement on Propolis Extraction at Varied pH and Alcohol Content. *Journal of Food Process Engineering*, *38*(6), 562–570. https://doi.org/10.1111/jfpe.12186

Yeo, Y. L., Chia, Y. Y., Lee, C. H., Sheng Sow, H., & Sum Yap, W. (2014). Effectiveness of Maceration Periods with Different Extraction Solvents on in-vitro Antimicrobial Activity from Fruit of Momordica charantia L. *Journal of Applied Pharmaceutical Science*, *4*(10), 16–23. https://doi.org/10.7324/japs.2014.401004

Yildirim, Z., Hacievliyagil, S., Kutlu, N. O., Aydin, N. E., Kurkcuoglu, M., Iraz, M., & Durmaz, R. (2004). Effect of water extract of Turkish propolis on tuberculosis infection in guinea-pigs. *Pharmacological Research*, *49*(3), 287–292. https://doi.org/10.1016/j.phrs.2003.10.007

Yu, A. X. D., Xu, M. L., Yao, P., Kwan, K. K. L., Liu, Y. X., Duan, R., Dong, T. T. X., Ko, R. K. M., & Tsim, K. W. K. (2020). Corylin, a flavonoid derived from Psoralea Fructus, induces osteoblastic differentiation via estrogen and Wnt/β-catenin signaling pathways. *FASEB Journal*, *34*(3), 4311–4328. https://doi.org/10.1096/fj.201902319RRR

Yuan, J., Lu, Y., Abula, S., Hu, Y., Liu, J., Fan, Y., Zhao, X., Wang, D., Liu, X., & Liu, C. (2013). Optimization on preparation condition of propolis flavonoids liposome by response surface methodology and research of its immunoenhancement activity. *Evidence-Based Complementary and Alternative Medicine*, *2013*. https://doi.org/10.1155/2013/505703

Yusook, K., Weeranantanapan, O., Hua, Y., Kumkrai, P., & Chudapongse, N. (2017). Lupinifolin from Derris reticulata possesses bactericidal activity on Staphylococcus aureus by disrupting bacterial cell membrane. *Journal of Natural Medicines*, *71*(2), 357–366. https://doi.org/10.1007/s11418-016-1065-2

Zaidiyah, Z., Ghifari, M. G. A., & Abubakar, Y. (2021). Extraction yield, antioxidant activity and total phenolic content of Mimusops elengi L. fruit. *IOP Conference Series: Earth and Environmental Science*, *922*(1). https://doi.org/10.1088/1755-1315/922/1/012021

Zhang, J., Shen, X., Wang, K., Cao, X., Zhang, C., Zheng, H., & Hu, F. (2016). Antioxidant activities and molecular mechanisms of the ethanol extracts of Baccharis propolis and Eucalyptus propolis in RAW64.7 cells. *Pharmaceutical Biology*, *54*(10), 2220–2235. https://doi.org/10.3109/13880209.2016.1151444

Zołnierczyk, A. K., Mączka, W. K., Grabarczyk, M., Wińska, K., Woźniak, E., & Anioł, M. (2015). Isoxanthohumol - Biologically active hop flavonoid. *Fitoterapia*, *103*, 71–82. https://doi.org/10.1016/j.fitote.2015.03.007

Zygler, A., Słomińska, M., & Namieśnik, J. (2012). Soxhlet extraction and new developments such as soxtec. *Comprehensive Sampling and Sample Preparation*, *2*, 65–82. https://doi.org/10.1016/B978-0-12-381373-2.00037-5