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Literature Review: Study of Antibacterial Activity of Sunflower (*Helianthus Annuus* L.) Extract and Its Phytochemical Profiles

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Abstract

Sunflower is one type of plant that grows in Indonesia. Sunflower plants contain secondary metabolites that have antibacterial activity. This study was conducted using a literature review approach to determine the antibacterial activity of sunflowers. The steps taken in this literature review are to collect, identify, evaluate, and interpret the antibacterial activity of sunflowers. Search results from keywords "Sunflower", "antibacterial", and "phytochemical profile" obtained as many as 1,834 articles, from several articles search results were then reviewed and obtained 8 articles that matched the inclusion and exclusion criteria. Various antibacterial activities of sunflower are effective against *Escherichia coli, Pseudomonas aeruginosa, Micrococcus luteus, Staphylococcus aureus, Bacillus subtilis, Propionibacterium acnes, Streptococcus uberis*, and *Aspergillus brasiliensis*. The results of phytochemical screening of sunflower leaves revealed the presence of terpenoids, sesquiterpenoids, triterpenoids, and steroids. The bioactive components found in sunflower leaves include Heliannuol M, Heliannuol D, helivypolides K, helivypolides L, helieudesmanolide, tambulin, pinoresinol and sesquiterpene 10-oxo-isodauc-3-en-15-al. Factors that affect antibacterial activity include ozonation conditions, acidity value, and oil concentration. Overall it can be concluded that sunflower extract can inhibit bacterial growth.

Keywords: sunflower, antibacterial, phytochemical profile

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is one type of plant that grows in Indonesia. Sunflowers, especially seeds, are seeds that can produce the largest vegetable oil in the world (Islam et al., 2016; Putri, 2020). Sunflower (*Helianthus annuus* L.) is one type of flower that can be consumed, especially the seeds. Sunflower seeds have many benefits both as food/snacks and medicinal ingredients (Zoumpoulakis et al., 2017; Putri, 2020).

One of the ingredients in sunflower seeds is phenolic compounds (Islam et al., 2016). Phenolic compounds can be used as antibacterials because they can increase the permeability of the cytoplasmic membrane, resulting in leakage of intracellular

components and cytoplasmic coagulation so that cell lysis will occur (Sudarmi, et al., 2017).

Sun seeds also contain active substances. The active substances contained in sunflower seeds include -sitosterol, flavonoids, and linoleic acid (Rodhiyah and Sulistiyawati 2012). In addition, sunflower seeds contain active substances, omega 9, omega 6, vitamin E, lecithin, tocopherols, and carotenoids (Kulkarni et al. 2015) (Donglikar and Deore 2017).

Sunflower seeds can be processed into oil. The oil produced by sunflower seeds contains amino acids such as linoleic acid 44-72% and oleic acid 11.7%. This oil can be used for various purposes, including cooking oil, making margarine, cosmetic raw materials, and medicines (Katja, 2012). In addition, sunflower seeds can also be used as raw materials for ethanol (Díaz et al., 2011).

Sunflower roots, stems, leaves, and seeds are reported to contain phenolics, flavonoids, and alkaloids (Kamal, 2011). In a previous study, sunflower buds were found to contain dietary fiber and phenolic acid (Liang et al., 2013). Sunflower petals were found to have triterpene glycosides, which have anti-inflammatory activity (Ukiya et al., 2007). Sunflower seed water extract was found to have considerable potential in reducing asthma symptoms (Heo et al., 2008) and high antioxidant activity (Giada and Mancini-Filho, 2009).

The results of processing sunflower petals can produce ethanol extract. The results showed that the ethanolic extract of sunflower petals (*Helianthus annuus* L.) had an analgesic effect on Swiss mice (Mus musculus) (Irianty, et al., 2014; Maudara, et al., 2016). This study is a literature review of sunflower plants (*Helianthus annuus* L.), specifically to explain parts of sunflower plants for their antibacterial activity and phytochemical profiles.

METHODS

This study uses a literature review approach. The stages of implementing a literature review include the stages of collecting, identifying, evaluating, and interpreting information about antibacterial activity in sunflowers.

Researchers conducted a comprehensive search through electronic databases. The search for articles in English and Indonesian is carried out through the Science Direct and Google Scholar databases. The article search process was carried out in January 2021. Keywords used in article search "bunga matahari", "anti bakteri", and "profil fitokimia'' for searches in Indonesian while keywords in English are used "sunflower", "antibacterial", "phytochemical profile".

The research articles obtained were then screened and selected according to the inclusion criteria which included: 1) research articles published in 2011-2020; 2) full text that can be accessed freely; 3) using experimental methods. While the exclusion criteria are articles that are the result of a review.

RESULTS AND DISCUSSION

The search results obtained as many as 1,834 articles. From the Science Direct database, 22 articles were obtained, from Google Scholar in English, 971 articles were obtained, and from Google Scholar in Indonesian, 841 articles were obtained. From several search results articles, a review was carried out and obtained 8 articles that matched the inclusion and exclusion criteria.

Research articles reviewed by researchers are briefly described as following:

Table 1. Article Analysis

NO	RESEARCHER	ARTICLE TITLE	PLANTS PARTS	BACTERIA	METHOD	RESULTS
1	Wulandari, Arian (2017)	Sunflower Seed Oil Nanogel (Helianthus annuus) As Antibacterial Against Staphylococcus aureus	Seed	Staphylococcus aureus	Well method	Has antibacterial activity against Staphylococcus aureus as indicated by the presence of a clear zone around the well-formed in the sample with the highest activity at a concentration of 7.5% with a diameter of 1.8132 cm.
2	Desianti, Aryani, Priani (2019)	Formulation and Effectiveness Test of Anti-Acne Emulgel Preparations of Sunflower Seed Oil (Helianthus Annuus L.) In Vitro Against Propionibacterium acnes	Seed	Propionibacterium acnes	Diffusion method so that the well	Has effectiveness against Propionibacterium acnes bacteria at concentrations of 10%, 15%, and 20% with an inhibition zone value of 9.92 mm, respectively; 10.65 mm and 13.65 mm.
3	Muti'ah, Hayati, and Triastutik (2013)	Separation and Identification of Sesquiterpene Crude Extract of Sunflower Leaf (Helianthus annuus L.) By Chromatography Thin Layer	Leaf	-	TLC fit phytochemical testing	The n-hexane extract contains a class of steroid compounds. Separation by TLC using n-hexane-ethyl acetate (8:2) eluent produced 4 spots with Rf values 0.10; 0.35; 0.61; and 0.68.
4	Sihotang (2017)	Sunflower Seed Oil Cream Formulation As Anti-Acne	Seed	Propionibacterium acnes.	Well method	The MIC value of sunflower seed oil is 1.5%. The formulation of the best sunflower seed oil W/A cream, both physically and chemically, is found in formula III which has a concentration of 9% glyceryl monostearate and 1% cetyl alcohol.
5	Aboki et al (2012)	Physicochemical and Anti-Microbial Properties of Sunflower (Helianthus annuus L.) Seed Oil	Seed	Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Bacillus subtilis	Kirby-Bauer agar agar diffusion method	The antibacterial activity showed an average inhibition zone of 15mm on Pseudomonas aeruginosa, 21mm on Escherichia coli, 25mm on Staphylococcus aureus.
6	Kartinings ih and Meilisa (2016)	Sunflower Seed Oil Cream Formulation As Anti-Acne With Glyceryl Monostearate And Cetyl Alcohol	Seed	Propionibacteriu m acnes	Liquid dilution	Sunflower seed oil was determined by the MIC value by liquid dilution method. The KHM value obtained is 1.5% In the preparation of sunflower seed oil cream and blank preparations, the results of the M/A type cream preparation are

						white, odorless with a soft, homogeneous texture, and there is no separation between phases after centrifugation.
7	Sophie Moureua, et al (2015)	Ozonation of sunflower oils: Impact of experimental conditions on the composition and the antibacterial activity of ozonized oils	-	Staphylococcus aureus, Escherichia coli, and Streptococcus uberis	Microdilution	In ozonated oils, the MIC ranges from 1.25 to 10.0 mg/mL against Staphylococcus aureus, from 2.5 to 40.0 mg/mL against Escherichia coli and from 2.5 to 40.0 mg/mL against Streptococcus uberis. .
8	Francesca Serio, et al (2017)	A New Formulation Based on Ozonated Sunflower Seed Oil: In Vitro Antibacterial and Safety Evaluation	Seed	Escherichia coli, Pseudomonas aeruginosa, Micrococcus luteus, Staphylococcus aureus.	Plate count	Oz.Or.Oil 30 (300 mg) produced growth inhibition zones in Gram-positive (Micrococcus luteus with a diameter of 21 mm and Staphylococcus aureus with a diameter of 23 mm) and Gram-negative reference bacteria (Escherichia coli with a diameter of 22.5 mm and Pseudomonas aeruginosa with a diameter of 20.75mm)

Sunflower is one type of flower that has been widely researched. In table 1. the sunflower parts that have been studied include sunflower seeds and leaves. Based on these data, it was obtained that there was quite strong information that the part of the plant that had the potential and had the strongest antibacterial activity was the seed of the sunflower plant. It was reported that sunflower seeds have antibacterial activity against *Staphylococcus aureus, Streptococcus uberis, Propionibacterium acnes, Pseudomonas aeruginosa, Escherichia coli, Bacillus subtilis, Micrococcus luteus.* (Aboki et al., 2012; Kartiningsih and Melisa, 2016; Moureu et al., 2015; Serio et al., 2017; Ariyani, 2017; Ariani et al., 2020; Desianti, 2019).

Sunflower seed oil (*Helianthus annuus* L.) emulgel preparations were effective against Propionibacterium acnes at concentrations of 10%, 15%, and 20% with inhibition zone values of 9.92 mm, respectively; 10.65 mm and 13.65 mm while the positive control (clindamycin 1%) had an inhibition zone of 24.75 mm (Desianti, 2019).

Sunflower extract is reported to contain the compound lutein. Sunflower extract had moderate-strong antibacterial activity against *Bacillus subtilis, E. coli, Salmonella typhi,* and *S. aureus* at a concentration of 1,000−50,000 ppm. At a concentration of 1,000 ppm, the antibiotic chloramphenicol already has strong antibacterial activity against 2 strains of bacteria, namely Salmonella typhi and Staphylococcus aureus. And only has moderate-strong antibacterial activity against 2 other bacterial strains, namely *Bacillus subtilis* and *Escherichia coli* (Kusmiati et al. 2021).

The results of the test of minimum inhibitory concentration (MIC) and minimum killing concentration (MBC) on sunflower stem extract against *Staphylococcus aureus* bacteria showed MIC results of 70 mg/mL while *Escherichia coli* bacteria were resistant to these extracts (Adetunji, 2014) .

Antibacterial activity in sunflowers is influenced by several factors. Factors that affect antibacterial activity include ozonation conditions, acidity value (Moureu et al. 2015), and oil concentration of 2.5%; 5%; 7.5% (Ariyani 2017). These various factors can increase the effectiveness of the work of sunflower extract.

The results obtained from antimicrobial studies look at the fact that oil from sunflower seeds is effective against several microorganisms such as *Staphylococcus aureus, Escherichia coli, Bacillus subtilis* which are commonly involved in urinary tract infections and diarrheal diseases which are one of the main causes of death in infants (Aboki et al. 2012).

From the description of the results above, it can be said that sunflower seed extract is more effective against gram-positive bacteria than gram-negative bacteria. It was proven that gram-positive bacteria had a MIC value that was greater than that of gram-negative bacteria, which tended to have a lower MIC value or even resistance.

Sunflowers are known to contain iodine. The results showed that the presence of a high iodine value indicated that the oil had a high content of unsaturated fatty acids and a free fatty acid value of 0.095 mgKOH/g and 0.042%, respectively (Aboki et al. 2012). In addition, the iodine index indicates the saturation level of the oil and corresponds to the quantity of iodine capable of reacting with the carbon-carbon double bonds of the oil (Moureua et al. 2015).

Sunflowers besides containing iodine also contain other substances. The results of the study by Kusmiati et al. (2021) showed that the results of phytochemical screening showed several secondary metabolites, namely steroids/triterpenoids, alkaloids, flavonoids, tannins, and saponins.

The bioactive components found in sunflower leaf extract include heliannuol M, helivypolides K, helivypolides L, and helieudesmanolide B (Zouhir, 2015). Compounds isolated from sunflower leaves are fatty acids, terpenes, flavonoids and heliannuol, then a bioassay was performed and the bioactive components were obtained, namely heliannuol D, tambulin, pinoresinol and sesquiterpene 10-oxo-isodauc-3-en-15-al (Gandara, 2019).

Sunflower seed analysis using spectrophotometry on flavonoid isolation showed chalcones kukulcan B, helianone A, flavanones heliannones B, flavanones heliannones C, and flavonol tambulin as bioactive compounds. Four tocopherol isomers (α, , and) are known to be present in sunflower seeds which contain helianthinin as globulin. While the sunflower petals are known to contain bioactive compounds, namely helianthoides. Heliangolide derivatives are found on sunflower stalks (Bashir, 2015).

Sunflower seeds contain phenolic compounds so that sunflower seeds can be used for various purposes. The results showed that sunflower seed extract was able to help heal wounds faster. The ability of sunflowers to accelerate the wound healing process comes from the content of active substances, including -sitosterol, flavonoids, and linoleic acid found in the sunflower seeds (Rodhiyah and Sulistiyawati, 2012; Pramushinta and Ajiningrum, 2018). In addition, sunflower seeds also contain linoleic acid which can inhibit the growth of Propionibacterium acnes (Desianti, 2019).

The antimicrobial activity of sunflower is due to its physicochemical properties. Determination of the physical and chemical properties of the oil includes the value of Free Fatty Acids (FFA), Acid Value (AV), Esters Value (EV), Saponification Value (SV), Iodine Value (IV), Peroxide Value (PV) and Specific Gravity (SG) (Aboki et al. 2012).

The results of phytochemical screening on sunflower leaves are known to contain terpenoids, sesquiterpenoids, triterpenoids, and steroids (Muti'ah, 2013; Hafidloh, 2014). Of the various compounds present in sunflowers, phenolic compounds are the compounds that have been studied the most and have the potential for treatment. Various studies have shown that phenolic compounds can help in wound healing, as antimalarial, accelerate healing of infections, cancer, and others. Besides that, so it can be used as an analgesic to reduce pain or soreness.

From the various articles that have been reviewed, it can be seen that various substances contained in sunflowers can be used as antibacterial. However, from the article, there are still weaknesses, including not yet comparing the antibacterial effects between one type of bacteria with another. In addition, the solvent used to extract sunflowers also varies in type and concentration, so that it is likely to affect the results of antioxidant activity.

CONCLUSION

Many studies have shown that the part of the sunflower that has the most potential to have beneficial pharmacological activities is the seed. Sunflower seeds are effective against *Staphylococcus aureus, Pseudomonas aeruginosa, Escherichia coli, Bacillus subtilis, Propionibacterium acnes, Streptococcus uberis, Aspergillus brasiliensis*.

Sunflowers contain 44-72% linoleic acid, 11.7% oleic acid, alkaloids, tannins, saponins, flavonoids, and terpenoids. Sunflower leaf extract has bioactive components including Heliannuol M, helivypolides K, helivypolides L, and helieudesmanolide B.

REFERERENCES

Aboki, MA et al. 2012. “Physicochemical and Anti-Microbial Properties of Sunflower (Helianthus annuus L.) Seed Oil.” International Journal of Science and Technology 2(4): 151–94.

Adetunji, CO et al. 2014. “Antimicrobial Activity of Ethanolic Extract of Helianthus annuus Stem” SMU Medical Journal 1(1): 79-88.

Ariani, Lusiana, Nur Miftahurrohmah, Kartiningsih, and Meilisa Ang. 2020. “Formulation of Sunflower Seeds Oil Cream (Helianthus annuus L.) with Variation of Cetyl Alcohol Concentration as Anti Acne.” Indonesian Journal of Pharmaceutical Sciences 18(2): 235–40.

Ariyani, Wulandari and Lilies Wahyu. 2017. “Sunflower Seed Oil Nanogel (Helianthus annuus L.) As Antibacterial Against Staphylococcus aureus Bacteria.” Scientific Journal of Scholar Exacts 7 (2002): 7–15.

Bashir, Tasneem et al. 2015. "Chemistry, Pharmacology and Ethnomedicinal Uses of Helianthus annuus (Sunflower): A Review." Pure and Applied Biology 4(2): 226-235.

Bozorgian, Alireza. 2020. “Study of the Effect Operational Parameters on the Supercritical Extraction Efficient Related to Sunflower Oil Seeds.” Chemical Review and Letters 3(May): 94–97.

Diaz, Manuel J. et al. 2011. "Hydrothermal Pre-Treatment and Enzymatic Hydrolysis of Sunflower Stalks." Fuel 90(11): 3225–29. http://dx.doi.org/10.1016/j.fuel.2011.06.040.

Desianti, Fika Evernia, Ratih Aryani, Sani Ega Priyani. 2019. "Formulation and Test of the Effectiveness of Anti-Acne Emulgel Preparations of Sunflower Seed Oil (Helianthus annuus L.) In Vitro Against Propionibacterium acnes". Pharmaceutical Proceedings 5(2): 344-351.

Donglikar, Mukund Manikrao, and Sharada Laxman Deore. 2017. "Development and Evaluation of Herbal Sunscreen." Pharmacognosy Journal 9(1): 83–97.

Gandara, F. Fuentes et al. 2019. "Selective fractionation and isolation of allelopathic compounds from Helianthus annuus L. leaves by means of high-pressure techniques." The Journal of Supercritical fluids 143: 32-41.

Giada, Maria DLR, and Jorge Mancini-Filho. 2009. "Antioxidant Capacity of the Striped Sunflower (Helianthus annuus L.) Seed Extracts Evaluated by Three in Vitro Methods." International Journal of Food Sciences and Nutrition 60(5): 395–401.

Heidari, Musa et al. 2018. "Study of the Ionization Potential, Electron Affinity and HOMO-LUMO Gaps in the Small Fullerene Nanostructures." Chem Rev Lett 1(2): 45–48. http://www.chemrevlett.com/article_85215.html.

Heo, Jin Chul et al. 2008. "Aqueous Extract of the Helianthus annuus Seed Alleviates Asthmatic Symptoms in Vivo." International Journal of Molecular Medicine 21(1): 57–61.

Irianty, Citra R, Jimmy Posangi, and P. M Wowor. 2014. "Test Analgesic Effects Of Ethanol Extract Of Sunflower Petals (Helianthus annuus L.) IN SWITCH MIICE (Mus Musculus)." Journal of e-Biomedicine (eBM) 2:1–6.

Islam, Rubab Tarannum, Mir Monir Hossain, Kishor Majumder, and Amjad Hossain Tipu. 2016. "In Vitro Phytochemical Investigation of Helianthus annuus Seeds." Bangladesh Pharmaceutical Journal 19(1): 100–105.

Kamal, Javed. 2011. "Quantification of Alkaloids, Phenols and Flavonoids in Sunflower (Helianthus annuus L.)." African Journal of Biotechnology 10(16): 3149–51.

Kamkar, Abolfazl, Ashkan Jebelli Javan, Farzad Asadi, and Mohammad Kamalinejad. 2010. "The Antioxidative Effect of Iranian Mentha Pulegium Extracts and Essential Oil in Sunflower Oil." Food and Chemical Toxicology 48(7): 1796–1800.

Katja, Dewa G. 2012. "Quality of Commercial Sunflower Oil and Extracted Oil of Sunflower Seeds (Helianthus annuus L.)." Scientific Journal of Science 12(1): 59.

Kulkarni, Snehal S, Rasida D Bhalke, Vishal V Pande, and Prakash Kendre. 2015. "Herbal Plants in Photo Protection and Sun Screening Action : An Herbal Plants in Photo Protection and Sun Screening Action : An." (February 2013).

Kusmiati, Endah Budi Ningsih, Indriati Ramadhani, and Mellova Amir. 2021. "Antibacterial and Antioxidant Activity Test of Crude Lutein Extracted from Sunflower (Helianthus Annuus L.)." AIP Conference Proceedings 2331(April).

Liang, Qiang et al. 2013. "Florets of Sunflower (Helianthus annuus L.): Potential New Sources of Dietary Fiber and Phenolic Acids." Journal of Agricultural and Food Chemistry 61(14): 3435–42.

Marsni, Zouhir El et al. 2015. "Isolation of Bioactive Compounds from Sunflower Leaves (Helianthus annuus L.) Extracted with Supercritical Carbon Dioxide." Journal of Agricultural and Food Chemistry 63: 6410-6421.

Ma Suara, Deny, Paulina VY Yamlean, and Sri Sudewi. 2016. "Test the Effectiveness of Sunflower Extract (Helianthus annuus L) As An In Vitro Analgetic Drug in Male White Mice (Mus muculus)." Pharmacon 5(1): 192–96.

Moureu, Sophie, Frédéric Violleau, Djamila Ali Haimoud-Lekhal, and Anne Calmon. 2015. "Ozonation of Sunflower Oils: Impact of Experimental Conditions on the Composition and the Antibacterial Activity of Ozonized Oils." Chemistry and Physics of Lipids 186: 79–85. http://dx.doi.org/10.1016/j.chemphyslip.2015.01.004.

———. 2016. "Influence of Storage Temperature on the Composition and the Antibacterial Activity of Ozonized Sunflower Oil." Ozone: Science and Engineering 38(2): 143–49.

Muti'ah, Roihatul, Elok, and Ijro'atul. 2012. "Potential Antimalarial Extract of Sunflower Leaf Dichloromethane (Helianthus annuus L.) In Vivo In Experimental Animals." Scientific 1(2).

Muti'ah, Roihatul, Elok Kamilah Hayati, and Yani Triastutik. 2013. "Separation and Identification of Sesquiterpene Crude Extract of Sunflower Leaves (Helianthus annuus L.) Using Thin Layer Chromatography." Alchemy 2(3).

Pramushinta, IAK, and PS Ajiningrum. 2018. "Transparent Solid Soap Preparation Formulation With The Addition Of Sunflower Seed Extract (Helianthus annuus L.)." STIGMA: Journal of Mathematics and Natural Sciences Unipa 11(01): 77–84.

Daughter, Aisyah Meisya. 2020. "Comparison of Antioxidant Activity of Sunflower Seeds (Halianthus Annuus L.) With Other Plants." Journal of Research and Education Chemistry 2(2): 85.

Putri, Enita Fitriani. 2016. Test of Sedating Effect of Helianthus annuus L. Leaf Extract with Graded Extraction Against Mice (Mus musculus) BALB/C Strain. Thesis.

Rodhiyah, and Sulistiyawati. 2012. "Effect of Sunflower (Helianthus annuus) Seed Oil Extract on the Early Process of Wound Healing." Environmental Science Biology 9(1): 706–11.

Serio, Francesca et al. 2017. "A New Formulation Based on Ozonated Sunflower Seed Oil: In Vitro Antibacterial and Safety Evaluation." Ozone: Science and Engineering 39(3): 139–47. http://dx.doi.org/10.1080/01919512.2016.1272405.

Sihotang, Supran Hidayat. 2017. "Sunflower Seed Oil Cream Formulation As Anti-Acne." Imelda Scientific Journal of Pharmacy 1(1): 26–29.

Sudarmi, Kadek, Ida Bagus Gede Darmayasa, and I Ketut Muksin. 2017. "Phytochemical and Inhibitory Test of Juwet Leaf Extract (Syzygium Cumini) Against Escherichia Coli AND Staphylococcus Aureus ATCC Growth." SYMBIOSIS Journal of Biological Sciences 5(2): 47.

Susanti, Yanthy, Anny Victor Purba, and Deni Rahmat. 2020. "Antioxidant and Spf Value of the Combination of Sesame Seed Oil (Sesamum Indicum L.) And Sunflower Seed Oil (Helianthus annuus L.)." Pharmaceutical Magazine 16(1): 107.

Ukiya, Motohiko et al. 2007. "Triterpene Glycosides from the Flower Petals of Sunflower (Helianthus annuus) and Their Anti-Inflammatory Activity." Journal of Natural Products 70(5): 813–16.

Zoumpoulakis, Panagiotis et al. 2017. "Evaluating Modern Techniques for the Extraction and Characterization of Sunflower (Helianthus annus L.) Seeds Phenolics." Antioxidants 6(3).