AJARCDE
ASIAN JOURNAL OF APPLIED RESEARCH FOR COMMUNITY DEVELOPMENT AND EMPOWERMENT

Journal home page: http://ajarcde-safe-network.org ISSN 2581-0405

Development of Agarwood Oil Research and Benefit: Bibliometric Analysis

Hendra Saputra[1], Benni Satria[2], Novizar Nazir[3] and Tuty Anggraini[3]*

[1] *Doctoral Program in Agriculture Science, Faculty of Agriculture, Andalas University, Indonesia,*
[2] *Department of Agrotechnology, Faculty of Agricultural, Andalas University, Indonesia*
[3]*Department of Food Technology and Agricultural Product, Faculty of Agricultural Technology, Andalas University, Indonesia*

ARTICLE INFO

Article History:
Received: 2 January 2024
Final Revision: 27 February 2024
Accepted: 29 February 2024
Online Publication: 03 March 2024

KEYWORDS

Agarwood oil, Benefit, Development, VOSviewer, Bibliometric Analysis, VOSviewe

CORRESPONDING AUTHOR

*E-mail: saputra22hendra@gmail.com

A B S T R A C T

Agarwood oil, derived from the fragrant resinous wood of the Aquilaria and Gyrinops trees, has attracted great attention due to its diverse pharmacological properties and commercial value. The complex chemical composition of agarwood oil, consisting of more than 150 chemical compounds, has been linked to its therapeutic potential in treating chronic inflammatory diseases, anxiety, depression, and insomnia. This research uses exploratory, descriptive research. The research used in this research is the literature study method regarding the development of agarwood oil research and its benefits. Documents from the Scopus website are saved in the following form: RIS-type files. Analysis was conducted using VOSviewer 1.6.18 for Windows software. The research results show that there has been a decline in the trend of research on agarwood oil over the last 10 years; most research on agarwood oil has been carried out by Malaysia and China and followed by Japan. Research has revealed numerous benefits of agarwood oil, indicating its potential for development into derivative goods, particularly in the health and fragrance industries.

1. INTRODUCTION

1.1. Research Background

Agarwood oil, derived from the fragrant resinous wood of Aquilaria and Gyrinops trees, has been historically valued for its medicinal, aromatic, and commercial properties [1]. The chemical composition of agarwood oil is complex, comprising over 150 chemical compounds, including terpenoids, sesquiterpenes, and derivatives of flindersiachromone [2]. Modern pharmacological studies have revealed that agarwood essential oil possesses antioxidant, antibacterial, anti-inflammatory, air-purifying, relaxing, and calming properties, making it a potential candidate for treating mental illnesses such as anxiety, depression, and insomnia [3]. Furthermore, agarwood oil has been investigated for its potential to ameliorate various health conditions, including gastric ulcers, pulmonary diseases, and myocardial ischemia, through its anti-inflammatory and antioxidative effects [4]–[6]. Additionally, agarwood oil has been recognized for its potential as an antianxiety and antidepressant agent, with studies demonstrating its ability to regulate the Glu/GABA system homeostasis [7].

The production of agarwood oil involves various extraction methods, with hydrodistillation being the preferred method for determining the essential oil content of agarwood [8]. Agarwood oil is widely used in cosmetic, perfume, and medicinal applications due to its unique characteristics and high medicinal value (Wang et al., 2021). Moreover, agarwood oil has been explored for its potential as an antifungal agent and for its application in edible films and hydrosol-based drinks [9], [10]. The high demand for agarwood oil has led to the development of artificial intelligent techniques for classifying its quality, emphasizing the significance of quality control in agarwood oil production [11], [12].

Based on the provided references, agarwood essential oil (AEO) has been found to possess a wide range of pharmacological properties. It has been reported to have antioxidant, antibacterial, and anti-inflammatory properties [3]. The volatile agarwood oil contains sesquiterpenes, particularly β-Caryophyllene, with significant antioxidant and antibacterial properties [13]. Additionally, the major constituents of agarwood oil have been shown to possess bioactive compounds that can regulate molecular mechanisms of chronic inflammation, making it useful for treating various inflammatory disorders [14]. Furthermore, agarwood oil, including its essential oils, is known for its potent antioxidant and anti-inflammatory properties [5].

Agarwood oil is widely used in cosmetic, perfume, and medicine due to its unique characteristics and high medicinal value [15]. It has been discovered that agarwood possesses various medicinal properties, such as anticancer, anti-inflammatory, analgesic, antidiabetic, antihistaminic, and antibacterial properties [16]. The chemical properties of agarwood oil have been used for its quality classification, and the grading process based on these properties has been proven to provide accurate results [17]. Moreover, agarwood oil is acknowledged as a pricey and valuable natural product owing to its benefits [18].

The bioactive composition of agarwood essential oil has been studied, and it has been found to have antifungal, antioxidant, and anticancer potential [19]. The main active compounds in agarwood are terpenoids, specifically sesquiterpenes, and the composition of oil extracted from agarwood is exceedingly complex, including over 150 chemical compounds [2]. Agarwood oil quality is often separated into two or three categories, and its extracts and main compounds have exhibited extensive pharmacological properties, including sedative, antineuroinflammatory, and laxative effects [15]. From this explanation, it is necessary to map the development of the number of research and research topics related to agarwood oil to see research gaps so that later new research related to agarwood oil can be discovered.

1.2. Objective

This research aims to determine research trends of agarwood research globally and explore the benefits of agarwood to facilitate future research mapping in the field.

2. METHODS

This research uses explorative, descriptive research. The research used in this research is the literature study method regarding the development of agarwood oil research and its benefits. Search data via the Scopus website (www.scopus.com) with the keywords: "Agarwood oil AND Agarwood oil benefit," YEAR LIMIT (2014-2024). Documents from the Scopus website are saved in the following form: RIS-type files. analysis was conducted using VOSviewer 1.6.18 for Windows software.

3. RESULT AND DISCUSSION

3.1. Development of Agarwood Oil Research

The development of agarwood oil research shows a quite drastic decline from 2020, which only produced journal articles with a total of 211 publications, the highest peak of publications related to agarwood oil in the last ten years from 2014 to 2024, namely in 2015 with a total of 528 publications and the peak in 2017 with the number of publications was 564 articles. This shows that the trend of agarwood oil research has decreased by looking at the publication in 2023, namely only one publication. In Figure 1, you can see a graph of the publication of agarwood oil per year. Let us look at the research development on agarwood oil. Much is carried out at several research institutions, namely, 27 affiliates from both campuses and forestry research institutions. Most of the research related to agarwood oil is carried out in Malaysia, namely at Universiti Teknologi MARA, Pahang University Malaysia, Forest Research Institute Malaysia, and International Islamic Universiti Malaysia. Then the second country that carries out a lot of agarwood research is China, which is carried out at the Chinese Academy of Medical Science and State Administration of Traditional Chinese, and further research was carried out by the Japanese State at Kyoto University. Figure 2 displays the progression of agarwood oil research across different campuses and research institutions.

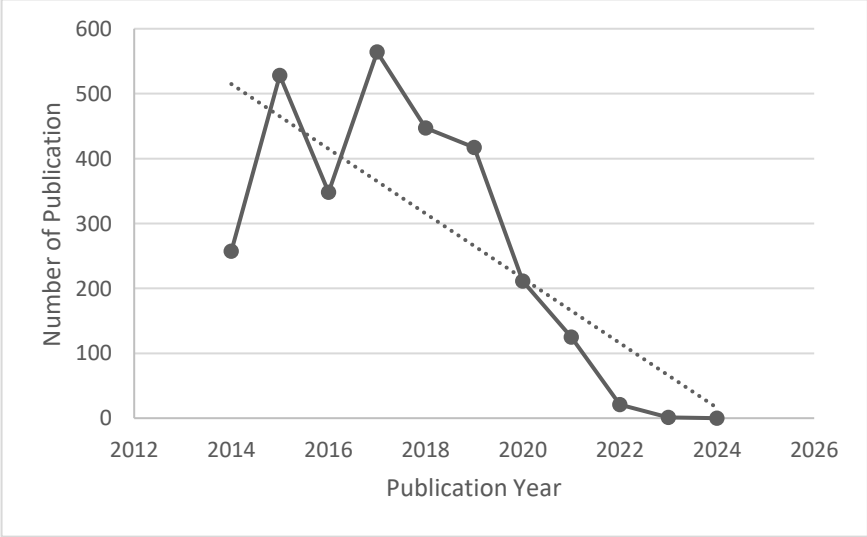

Fig. 1. Graph of Number of Publications by Year

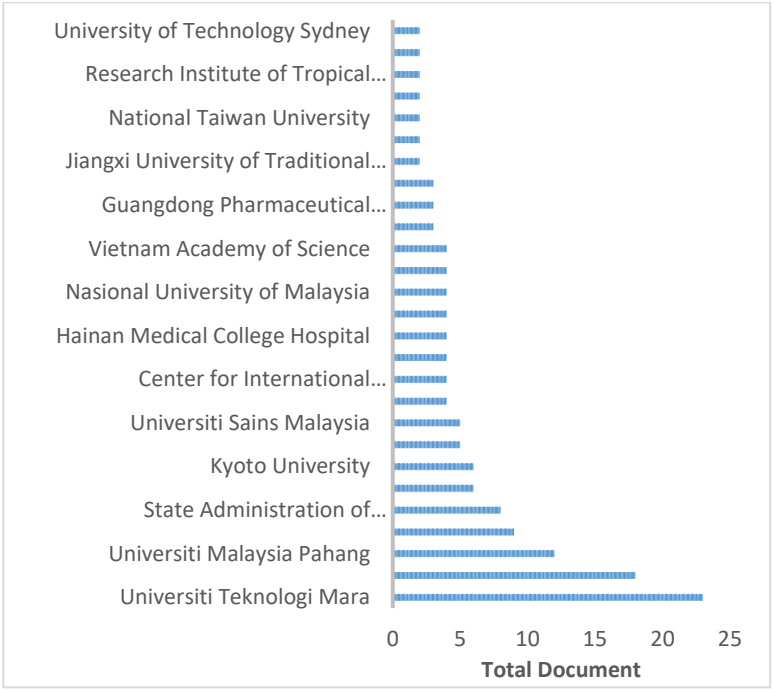

Fig. 2. The Highest Affiliation In the Publication Of Scientific Journals or Articles

Furthermore, in the development of journals which have become information media in agarwood oil research, there are 10 favorite journals including the Molecules journal which has produced 25 journal articles, the Iop Conference Series Eart and Environmental Science with 9 articles and the Journal of Agriculture and Food Chemistry with 8 articles and the Forest journal with 9 articles. 5 published articles. Developments in agarwood oil study are evident in numerous journals that are the most prolific in publishing articles on agarwood oil, serving as valuable references.

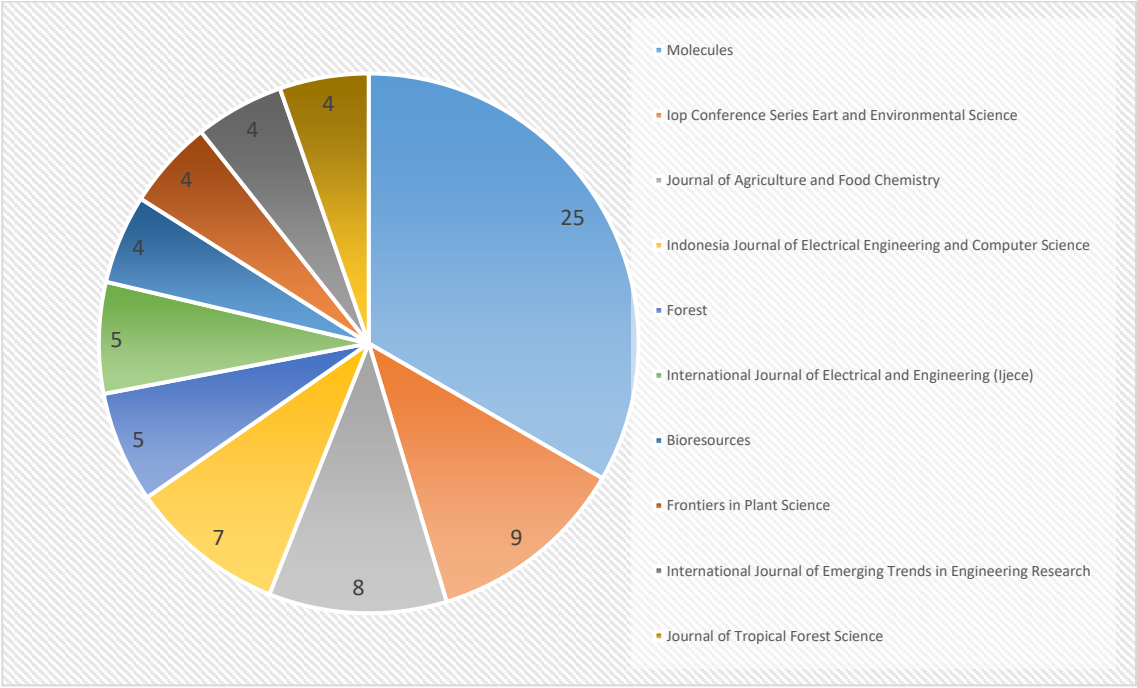

Fig. 3. The Highest Journal In the Publication Of Scientific Journals or Articles

3.2. Research Development Map of Agarwood Oil

From Vosviewer, mapping the development of agarwood oil research is obtained through the selected keywords, as seen in Fig. 4 and Fig. 5.

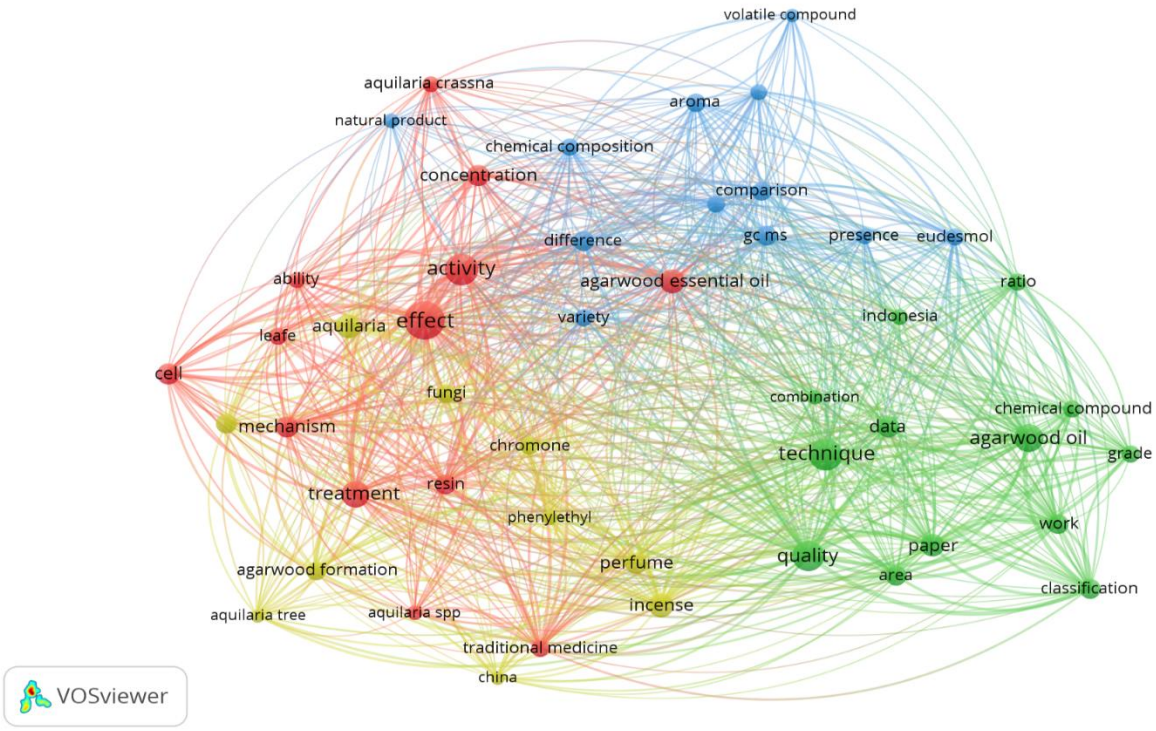

Fig. 4. Network Visualization Results of Topic Mapping of Agarwood Oil

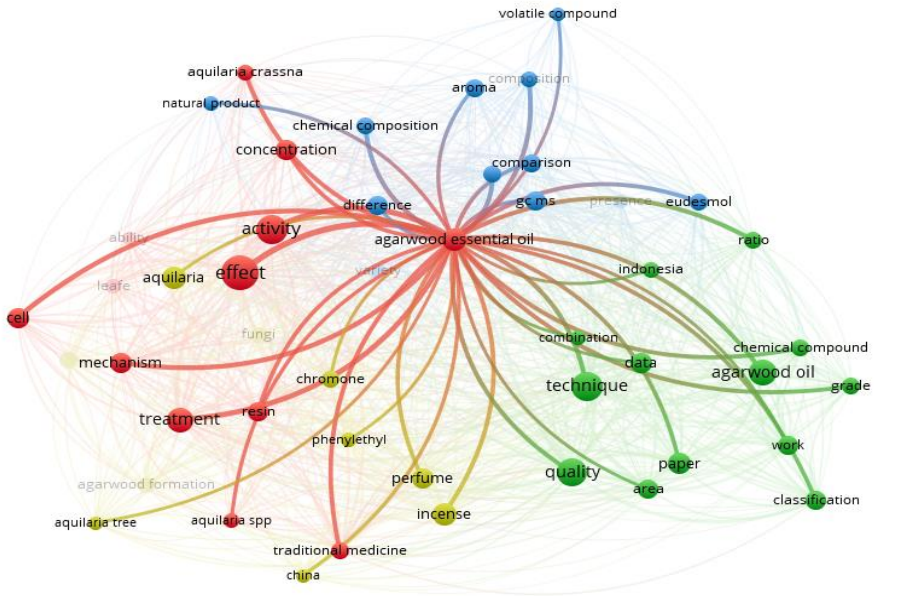

Fig. 5. Network Visualization of Topic Agarwood Essential Oil

We can see that many topics are discussed in agarwood oil research, namely technique, quality, treatment, effects, cells, activity, combination, concentration, and chemical composition. Several research topics that have not been widely developed include derivative products such as perfume, traditional medicine, volatile components, and natural products. Therefore,

several studies related to agarwood oil can be developed from several topics that have not been studied so that research gaps and novelties can be found in subsequent research.

3.3. Agarwood Oil Properties

Agarwood essential oil (AEO) has gained attention due to its potential therapeutic properties. Studies have shown that AEO possesses antioxidant, antibacterial, and anti-inflammatory properties [3]. The volatile agarwood oil contains sesquiterpenes, particularly β-Caryophyllene, with significant antioxidant and antibacterial properties [13]. The major constituents of agarwood oil have been found to regulate molecular mechanisms of chronic inflammation, indicating its potential for treating various inflammatory disorders [14]. Additionally, agarwood oil is known for its potent antioxidant and anti-inflammatory properties, making it valuable in treating pulmonary diseases and chronic obstructive pulmonary disease [5].

Furthermore, agarwood oil has been widely used in cosmetic, perfume, and medicine due to its unique characteristics and high medicinal value [4]. The medicinal properties of agarwood include anticancer, anti-inflammatory, analgesic, antidiabetic, antihistaminic, anxiolytic, antibacterial, hepatoprotective, and neural activity improvement [16]. The high demand for agarwood oil in the global market is attributed to its numerous benefits and unique properties [18]. The aromatic compound hydrosol of agarwood is believed to have similar chemical properties to essential oils, exhibiting positive antioxidant and biological activity for living cells [10].

The chemical composition of agarwood oil is complex, comprising over 150 chemical compounds, including terpenoids and derivatives of flindersiachromone [2]. Due to its multiple benefits, agarwood essential oil is highly regarded universally and often called "black gold" [20]. The extracts, essential oil, and main compounds from agarwood have exhibited a wide array of pharmacological properties, such as laxative, antinociceptive, antineuroinflammatory, and neuroprotective effects [21].

3.4. Agarwood Oil Benefits

Agarwood oil, derived from the Aquilaria tree, has been traditionally used for its medicinal properties, especially in the treatment of gastrointestinal diseases [15]. The oil is known for its bioactivity in controlling fungal pathogens and possesses unique medicinal properties [1]. Furthermore, agarwood oil has been found to exert antianxiety and antidepressant effects through the regulation of the Glu/GABA system homeostasis [22]. Modern pharmacology has identified agarwood essential oil as having antioxidant, antibacterial, anti-inflammatory, air-purifying, relaxing, and calming properties [3].

In addition to its medicinal benefits, agarwood oil has been explored for various applications, such as in edible films for potential use as an antifungal agent for fruits [23]. Quality control analysis of agarwood oil has been conducted using thermogravimetric analysis to ensure its purity and authenticity [24]. Moreover, agarwood essential oil has been found to possess antimicrobial activity against various pathogens, further highlighting its potential in medical applications[25]. The traditional efficacy and modern applications of agarwood suggest its potential use in treating myocardial ischemia injury [21]. The oil is widely used in cosmetics, perfumes, and medicine due to its unique characteristics and high medicinal value [15].

The high demand for agarwood oil, especially in regions such as the Middle East, Japan, and China, is attributed to its use in incense, traditional medicine, and religious ceremonies [26] . Research has also revealed the various medicinal properties of agarwood, including anticancer, anti-inflammatory, analgesic, antidiabetic, antihistaminic, antibacterial, and hepatoprotective effects [16]. The extraction of agarwood oil is mainly carried out through techniques such as water distillation, steam distillation, solvent extraction, and supercritical fluid extraction, emphasizing its significance in producing expensive essential oil [27].

4. CONCLUSION

The research results show that there has been a decline in the trend of agarwood oil research over the last 10 years, most research on agarwood oil has been carried out by Malaysia, China and followed by Japan. The journal that publishes the most articles about agarwood oil is the journal Molecules and the affiliate that carries out the most research is the Universiti Technologi Mara. The chemical composition of agarwood oil is complex, comprising over 150 chemical compounds, including terpenoids. Due to its multiple benefits, agarwood essential oil is highly regarded universally and often called "black gold." The extracts, essential oil, and main compounds from agarwood have exhibited various pharmacological properties, such as laxative, antinociceptive, antineuroinflammatory, and neuroprotective effects. Its complex chemical composition and unique properties make it a valuable resource with potential applications in various fields, including medicine, cosmetics, and perfumery. agarwood oil offers various medicinal benefits, including antioxidant, anti-inflammatory, and antimicrobial properties, making it a valuable resource in traditional medicine and modern pharmacology. Its unique chemical composition and diverse applications underscore its significance in various fields, from healthcare to commercial industries.

REFERENCE

[1] P. Shivanand, N. F. Arbie, S. Krishnamoorthy, and N. Ahmad, “Agarwood—The Fragrant Molecules of a Wounded Tree,” *Molecules*, 2022, doi: 10.3390/molecules27113386.

[2] W. Nong *et al.*, “Chromosomal-level Reference Genome of the Incense Tree Aquilaria Sinensis,” *Mol. Ecol. Resour.*, 2020, doi: 10.1111/1755-0998.13154.

[3] X. Chen *et al.*, “Chemical Composition and Potential Properties in Mental Illness (Anxiety, Depression and Insomnia) of Agarwood Essential Oil: A Review,” *Molecules*, 2022, doi: 10.3390/molecules27144528.

[4] Y. Wang *et al.*, “Aquilaria Species (Thymelaeaceae) Distribution, Volatile and Non-Volatile Phytochemicals, Pharmacological Uses, Agarwood Grading System, and Induction Methods,” *Molecules*, 2021, doi: 10.3390/molecules26247708.

[5] G. De Rubis *et al.*, “Agarwood Oil Nanoemulsion Attenuates Cigarette Smoke-Induced Inflammation and Oxidative Stress Markers in BCi-NS1.1 Airway Epithelial Cells,” *Nutrients*, 2023, doi: 10.3390/nu15041019.

[6] Y. Xie *et al.*, “Rapid Authentication of Agarwood by Using Liquid Extraction Surface Analysis Mass Spectrometry (LESA-MS),” *Phytochem. Anal.*, 2020, doi: 10.1002/pca.2944.

[7] F. Chen *et al.*, "Comprehensive Comparisons Between Grafted Kynam Agarwood and Normal Agarwood on Traits, Composition, and in Vitro Activation of AMPK," *Molecules*, 2023, doi: 10.3390/molecules28041667.

[8] Z. Yu *et al.*, "Identification of Aroma-active Components From Cultivated Agarwood 'Qi-Nan' Based on GC-O-MS Combined With Aroma Extract Dilution Analysis," *Flavour Fragr. J.*, 2023, doi: 10.1002/ffj.3754.

[9] L. P. Wigati, "Edible film of native jicama starch, agarwood Aetoxylon Bouya essential oil and calcium propionate: Processing, mechanical, thermal properties and structure," *Int. J. Biol. Macromol.*, vol. 209, pp. 597–607, 2022, doi: 10.1016/j.ijbiomac.2022.04.021.

[10] E. E. M. Kahar, "Properties and potential of agarwood hydrosol as a drink: A review," *Food Research*, vol. 5, no. 3. pp. 29–35, 2021. doi: 10.26656/fr.2017.5(3).382.

[11] S. M. H. M. Huzir, N. Z. Mahabob, A. F. M. Amidon, S. Sulhadi, Z. M. Yusoff, and M. N. Taib, "A Ppreliminary Study on the Intelligent Model of K-Nearest Neighbor for Agarwood Oil Quality Grading," *Indones. J. Electr. Eng. Comput. Sci.*, 2022, doi: 10.11591/ijeecs.v27.i3.pp1358-1365.

[12] A. F. M. Amidon, S. M. H. M. Huzir, Z. M. Yusoff, N. Ismail, and M. N. Taib, "The Significance of Artificial Intelligent Technique in Classifying Various Grades of Agarwood Oil," *Indones. J. Electr. Eng. Comput. Sci.*, 2022, doi: 10.11591/ijeecs.v29.i1.pp261-269.

[13] S. Tao *et al.*, "Therapeutic Potential of Agarwood in Oral Chronic Inflammatory Diseases Management," *Int. J. Homeopath. &Amp; Nat. Med.*, 2022, doi: 10.11648/j.ijhnm.20220802.12.

[14] K. R. Paudel *et al.*, "Rediscovering the Therapeutic Potential of Agarwood in the Management of Chronic Inflammatory Diseases," *Molecules*, 2022, doi: 10.3390/molecules27093038.

[15] W. Wang *et al.*, "Subcritical Low Temperature Extraction Technology and Its Application in Extracting Seed Oils," *J. Food Process Eng.*, 2021, doi: 10.1111/jfpe.13805.

[16] A. M. A. Mokhtar, "Overview of Medicinal Properties and Toxicities of Agarwood Species," *Educ. J. Sci. Math. Technol.*, 2021, doi: 10.37134/ejsmt.vol8.2.1.2021.

[17] N. Z. Mahabob, "A novel application of artificial neural network for classifying agarwood essential oil quality," *Int. J. Electr. Comput. Eng.*, vol. 12, no. 6, pp. 6645–6652, 2022, doi: 10.11591/ijece.v12i6.pp6645-6652.

[18] S. M. H. M. Huzir *et al.*, "Stepwise Regression of Agarwood Oil Significant Chemical Compounds Into Four Quality Differentiation," *Indones. J. Electr. Eng. Comput. Sci.*, 2023, doi: 10.11591/ijeecs.v29.i2.pp735-741.

[19] A. Hidayat *et al.*, "Bioactive Composition, Antifungal, Antioxidant, and Anticancer Potential of Agarwood Essential Oil From Decaying Logs (Gyrinops Spp.) of Papua Island (Indonesia)," *J. Appl. Pharm. Sci.*, 2021, doi: 10.7324/japs.2021.1101010.

[20] A. H. 'Izzati H. Al-Hadi, "Pattern Analysis on ≪em>Aquilaria Malaccensis</Em> Using Machine Learning," *Bull. Electr. Eng. Informatics*, 2024, doi: 10.11591/eei.v13i1.5562.

[21] C. Wang, D. Peng, Y. Liu, Z. Yu, P. Guo, and J. Wei, "Agarwood Alcohol Extract Ameliorates Isoproterenol-Induced Myocardial Ischemia by Inhibiting Oxidation and Apoptosis," *Cardiol. Res. Pract.*, 2020, doi: 10.1155/2020/3640815.

[22] C. Wang, B. Gong, Y. Liu, D. Chen, Y. Wu, and J. Wei, "Agarwood Essential Oil Inhalation Exerts Antianxiety and Antidepressant Effects via the Regulation of Glu/Gaba System Homeostasis," *Biomed. Reports*, 2023, doi: 10.3892/br.2023.1598.

[23] L. P. Wigati, A. A. Wardana, and F. Tanaka, "Characterization of Edible Film Based on Yam Bean Starch, Calcium Propionate and Agarwood Bouya Essential Oil," *Iop Conf. Ser. Earth Environ. Sci.*, 2022, doi: 10.1088/1755-1315/1038/1/012066.

[24] P. Kumar, S. Tripathi, P. K. Rout, S. K. Khare, and S. Naik, "Quality Control Analysis of High-value Agarwood Oil by Thermogravimetric Analysis (TGA)," *Flavour Fragr. J.*, 2022, doi: 10.1002/ffj.3721.

[25] N. Mahathaninwong, T. Chucheep, S. Karrila, W. Songmuang, N. Rodsang, and S. Limhengha, "Morphology and Properties of Agarwood-Waste-Filled Natural Rubber Latex Foam," *Bioresources*, 2020, doi: 10.15376/biores.16.1.176-189.

[26] M. A. H. Abas, "Agarwood Oil Quality Classification Using Support Vector Classifier and Grid Search Cross Validation Hyperparameter Tuning," *Int. J. Emerg. Trends Eng. Res.*, 2020, doi: 10.30534/ijeter/2020/55862020.

[27] F. Zakaria, B. A. Talip, E. E. M. Kahar, N. Muhammad, N. Abdullah, and H. Basri, "Solvent used in extraction process of agarwood: A systematic review," *Food Res.*, vol. 4, no. 3, pp. 731–737, 2020, doi: 10.26656/fr.2017.4(3).333.