



Inventory of Medicinal Plants Used by the Community of Rano Village, Balaesang Tanjung District, and Their Potential as Biology Learning Media

¹Nunink, ²I Nengah Kundera, ³I Made Budiarsa, ⁴Musdalifah Nurdin, ⁵Vita Indri Febriani, ⁶Masrianih

^{1,2,3,4,5,6}Department of Biology Education, Faculty of Teacher Training and Education, Tadulako University, Palu, Indonesia.

*Corresponding Author e-mail: nengahkundera@gmail.com

Received: December 2025; Revised: February 2026; Accepted: February 2026; Published: March 2026

Abstract: This study aims to inventory the plant species utilized by the local community as medicinal resources in Rano Village, Balaesang Tanjung Sub-district, and to examine their potential use as instructional learning media. The study employed a descriptive research design with a qualitative approach. Primary data were collected directly through interviews and field observations using a survey method with purposive sampling. Data collection techniques included direct observation, community interviews, and documentation of field findings. In the local context, a traditional healer (sando) plays a significant role as a key informant due to their extensive knowledge regarding the identification and use of medicinal plants. The results of the study revealed that the community utilizes 22 species of medicinal plants belonging to 14 plant families to treat various ailments, including rheumatism, asthma, hypertension, itching, scabies, cough, influenza, and several other health conditions. The plant parts used include leaves, stems, fruits, roots, bark, shoots, sap, and in some cases the entire plant. The preparation and utilization methods commonly practiced by the community include pounding, boiling, topical application, and direct consumption. Based on these findings, the documented information on medicinal plant utilization has strong potential to be developed as instructional media in the form of an educational e-book to support biology learning.

Keywords: Inventory; medicinal plants; learning media

How to Cite: Nunink, Kundera, I. N., Budiarsa, I. M., Nurdin, M., Febriani, V. I., & Masrianih. (2026). Inventory of Medicinal Plants Used by the Community of Rano Village, Balaesang Tanjung District, and Their Potential as Biology Learning Media. *Bioscientist: Jurnal Ilmiah Biologi*, 14(1), 13–22. <https://doi.org/10.33394/bioscientist.v14i1.19643>



<https://doi.org/10.33394/bioscientist.v14i1.19643>

Copyright©2026, Nunink et al

This is an open-access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) License.



INTRODUCTION

Biodiversity represents one of the most important natural resources supporting human health and the development of natural product-based medicines. Medicinal plants have long been used as part of traditional healthcare systems in many parts of the world and continue to serve as a major source for the discovery of new bioactive compounds in modern pharmaceutical research (Atanasov et al., 2021; Heinrich et al., 2020). The World Health Organization (WHO) reports that approximately 80% of the population in developing countries still rely on plant-based traditional medicine as part of their primary healthcare system (WHO, 2019). This condition highlights the significant role of medicinal plants not only in public health but also in the advancement of scientific knowledge and the development of pharmaceutical industries based on biological resources.

Globally, research on medicinal plants continues to grow alongside increasing attention toward natural product-based therapies that are considered safer and more sustainable. Medicinal plants are known to contain various bioactive compounds, including alkaloids, flavonoids, terpenoids, and phenolic compounds, which exhibit diverse pharmacological activities such as antioxidant, antimicrobial, anti-inflammatory, and antidiabetic effects (Atanasov et al., 2021; Jamshidi-Kia et al., 2018). Therefore, the exploration and documentation of medicinal plant diversity are

essential for supporting the discovery of new therapeutic agents as well as the conservation of biological resources.

Indonesia is recognized as one of the world's megabiodiversity countries with exceptionally rich floral diversity. It is estimated that more than 30,000 plant species occur in Indonesia, thousands of which have potential as medicinal plants utilized by local communities in traditional healing practices (Widjaja et al., 2020; Zuhud et al., 2021). The use of medicinal plants in Indonesia is driven not only by the abundance of biological resources but also by the presence of traditional knowledge passed down through generations within local communities. This knowledge encompasses various aspects, including the identification of medicinal plant species, the plant parts used, and the preparation and application methods for treating different diseases (Sujarwo & Caneva, 2016; Silalahi et al., 2019).

Ethnobotanical studies conducted in various regions of Indonesia demonstrate that local communities possess extensive knowledge regarding the use of medicinal plants. Several studies report that a single local community may utilize dozens to hundreds of plant species to treat a wide range of diseases, from minor ailments to chronic conditions (Silalahi et al., 2019; Suryadarma et al., 2022). Moreover, medicinal plants are often integrated into culturally based health practices that are closely associated with local belief systems and traditions. Consequently, research on medicinal plants is not only related to botanical and pharmacological aspects but also involves social, cultural, and biodiversity conservation dimensions.

Although medicinal plants are still widely used by communities, knowledge related to their utilization is generally transmitted orally through local traditions. This condition makes traditional knowledge about medicinal plants vulnerable to loss due to social change, modernization, and the declining number of individuals who possess knowledge of traditional healing practices (Heinrich et al., 2020; Paniagua-Zambrana et al., 2020). Therefore, documenting ethnobotanical knowledge is an important step in preserving local wisdom while simultaneously contributing to biodiversity conservation.

In addition to scientific documentation, advances in information technology also provide new opportunities for preserving local knowledge. The digitalization of information through digital media such as electronic books (e-books) enables broader and more efficient storage and dissemination of information. Compared with printed books, e-books offer several advantages, including ease of access, flexible distribution, and the ability to incorporate various multimedia elements such as images, graphics, and digital links that enrich information presentation (Mayer, 2020; Li & Tsai, 2017). In the context of documenting medicinal plants, e-books can present essential information such as local and scientific plant names, botanical classification, plant parts utilized, active compound content, and visual documentation of each species.

One area with considerable potential for medicinal plant diversity is Rano Village, located in Balaesang Tanjung District, Donggala Regency. Most of the residents in this village work as farmers and have a strong dependence on surrounding natural resources. Limited access to modern healthcare services, combined with the persistence of traditional healing practices, has led the community to continue utilizing various plant species as alternative medicine. In practice, knowledge of medicinal plant use is also maintained by local traditional healers known as *sando*, who play an important role in treating various diseases using herbal preparations derived from local plants.

Despite the continued use of medicinal plants within the community, information regarding the diversity of medicinal plant species, the plant parts utilized, and their

methods of use in Rano Village has not yet been systematically documented. Previous studies have largely focused on the inventory of medicinal plants in different regions of Indonesia; however, studies integrating ethnobotanical documentation with digital media as a means of information dissemination remain relatively limited. In fact, a digital-based documentation approach has the potential to serve as an effective strategy for preserving local knowledge while simultaneously improving the accessibility of information for a wider audience.

Based on the above considerations, this study offers novelty through the documentation of local knowledge regarding the use of medicinal plants in Rano Village combined with the presentation of information in a digital format in the form of an e-book. This approach not only contributes to the development of ethnobotanical studies but also supports the preservation of traditional knowledge and the conservation of medicinal plant diversity. Therefore, this study aims to identify the plant species used as medicinal plants by the community of Rano Village, the plant parts utilized, and the types of diseases that can be treated based on local community knowledge.

METHOD

This study employed a qualitative descriptive approach aimed at systematically describing the utilization of medicinal plants by the local community based on the indigenous knowledge preserved in Rano Village. This approach was used to explore information regarding the types of medicinal plants, the plant parts utilized, methods of preparation, and the types of diseases treated within the community's traditional healing practices. Through this approach, the researchers were able to obtain a comprehensive understanding of medicinal plant utilization based on the experiences and knowledge of the local community (Ridwan et al., 2021).

The research was conducted in Rano Village, Balaesang Tanjung District, Donggala Regency, in March 2025. The study site was selected because the local community still actively utilizes various plant species for traditional medicine and maintains well-preserved indigenous knowledge regarding the use of medicinal plants. Informants were selected using purposive sampling, a technique in which participants are deliberately chosen based on specific criteria relevant to the research objectives. The research informants consisted of community members possessing knowledge and experience in the use of medicinal plants, including traditional leaders, traditional healers (*sando*), and community members who actively use or cultivate medicinal plants. In-depth interviews were conducted with three key informants who were considered to have extensive knowledge of traditional medicine: Kai Teng (89 years old), the customary elder of Rano Village; Mr. Nurman (49 years old), a farmer knowledgeable about the use of medicinal plants in daily life; and Mrs. Handodo (53 years old), a housewife and traditional massage practitioner who frequently utilizes herbal plant-based remedies in healing practices.

The objects of this study were various plant species utilized by the people of Rano Village as traditional medicinal resources. The selection of research objects was based on several criteria: plants recognized by the community as having medicinal properties, plants still used in traditional healing practices, and plants that grow naturally or are cultivated within the Rano Village area. Each plant species meeting these criteria was subsequently documented and identified based on direct field observations and information obtained from informants. The collected data included the local and scientific names of the plants, the plant parts utilized, their medicinal uses, and the methods of preparation and application by the community.

Primary data were obtained through field observations, in-depth interviews, and documentation studies. Observations were conducted directly around community settlements to identify medicinal plant species using observation sheets containing information on local plant names, scientific names, plant parts utilized, and their medicinal functions or benefits. Semi-structured interviews were conducted using an interview guide to obtain information about the plant species used, the plant parts utilized, preparation methods, and the diseases treated. In addition, an exploration method was applied by surveying areas surrounding residential zones, gardens, and natural environments around the village to locate and document various medicinal plants used by the community.

Secondary data were obtained through a literature review of various written sources such as books, scientific articles, and journals related to medicinal plants and ethnobotany. Plant identification was carried out by comparing the morphological characteristics of plants found in the field with relevant botanical references and scientific literature on medicinal plants. The collected data were then analyzed using qualitative descriptive analysis techniques through the stages of data reduction, data presentation, and conclusion drawing. The results of the analysis were presented in the form of descriptive narratives supported by tables and photographic documentation to illustrate the types of medicinal plants, the plant parts utilized, and their methods of use in the traditional medicinal practices of the Rano Village community.

RESULTS AND DISCUSSION

The results of observations and interviews with traditional healers (*sando*) and members of the community in Rano Village revealed that the number of medicinal plant species currently found in the area is relatively limited. This condition is largely attributed to the increasing expansion of agricultural land through the clearing of shrublands and forest areas. The field investigation conducted in Rano Village identified 22 plant species belonging to 14 families that are utilized by the local community for medicinal purposes. The plant parts commonly used as medicine include roots, stems, leaves, and fruits. In preparing herbal remedies, some plant species are used individually without being mixed with other plants.

Each medicinal plant species has specific dosage requirements and usage periods, depending on the type of ailment being treated. Generally, treatment is administered when symptoms appear, and herbal preparations—particularly those taken orally—are typically consumed two to three times per day. The medicinal plant species identified in this study are presented in Table 1.

Table 1. Medicinal plant species utilized by the community

Scientific Name	Local Name	Plant Part Used	Reported Medicinal Use	Preparation Method	Dosage
<i>Ficus septica</i>	Awar-awar	Leaves	Treatment for rheumatism	Leaves are pounded	3x daily
<i>Phyllanthus urinaria</i>	Meniran	Stems, leaves, fruits	Treatment for gastric and liver disorders	Boiled and consumed as decoction	3x daily
<i>Hyptis capitata</i>	Genggeyan	Leaves	Reduction of body odor	Leaves are pounded	1x daily
<i>Scleria sumatrensis</i>	Rija-rija	Fruits	Treatment for boils	Fruits are eaten directly	3x daily
<i>Peperomia pellucida</i>	Sirih Cina	Stems, leaves	Treatment for hypertension	Boiled and consumed as decoction	3x daily
<i>Bidens pilosa</i>	Ketul	Leaves	Treatment for scabies	Leaves are pounded	1x daily
<i>Physalis angulata</i>	Ceplukan	Stems, leaves, fruits	Treatment for asthma and hypertension	Boiled and consumed as decoction	3x daily

Scientific Name	Local Name	Plant Part Used	Reported Medicinal Use	Preparation Method	Dosage
<i>Tetracera scandens</i>	Mempelas	Leaves	Treatment for bloody diarrhea	Boiled and consumed as decoction	3x daily
<i>Chromolaena odorata</i>	Rumput Minjangan	Leaves	Wound treatment	Leaves are pounded and applied	1x daily
<i>Cheilocostus speciosus</i>	Pacing Tawar	Stems	Treatment for internal heat/feverish conditions	Stem is scraped and consumed	2-3x daily
<i>Ageratum conyzoides</i>	Bandotan	Leaves	Treatment for stomachache	Leaves are pounded	3x daily
<i>Rubus rosifolius</i>	Arbei Gunung	Fruits	Treatment for cough	Fruits are eaten directly	2-3x daily
<i>Conyza canadensis</i>	Rumput Kuda	Leaves	Treatment for tinea versicolor	Leaves are pounded	1x daily
<i>Neolamarckia cadamba</i>	Jabon	Leaves, bark	Treatment for jaundice	Boiled or chewed	2x daily
<i>Rubus moluccanus</i>	Nggalat	Leaves	Treatment for vaginal discharge	Leaves are chewed	2x daily
<i>Blumea balsamifera</i>	Sembung	Leaves	Treatment for stomachache	Leaves are pounded	1-2x daily
<i>Eclipta prostrata L.</i>	Urang-aring	Stems, leaves, fruits	Treatment for malnutrition	Plant parts are pounded	2x daily
<i>Piper betle L.</i>	Sirih	Leaves, fruits	Treatment for itching, nosebleeds, and gastric disorders	Leaves are pounded	2x daily
<i>Alchornea cordifolia</i>	Semak Natal	Leaves	Postpartum care	Leaves are rubbed onto the hands/body	2x daily
<i>Decalobanthus peltatus</i>	Mantangan	Sap/blood-like exudate	Wound treatment	Sap is applied directly	2x daily
<i>Melastoma</i>	Senggani	Leaves	Treatment for breast cancer (traditional claim)	Boiled and consumed as decoction	2-3x daily
<i>Stachytarpheta jamaicens</i>	Pecut Kuda	Leaves	Treatment for influenza	Boiled and consumed as decoction	2-3x daily

Types of Medicinal Plants in Rano Village

A total of 22 medicinal plant species belonging to 14 families were documented in Rano Village. The identified medicinal plant species were distributed across the following families: Moraceae (1 species), represented by *Ficus septica*; Euphorbiaceae (2 species), namely *Phyllanthus urinaria* L. and *Alchornea cordifolia*; Lamiaceae (1 species), *Hyptis brevipes*; Cyperaceae (1 species), *Scleria sumatrensis*; Piperaceae (2 species), *Peperomia pellucida* and *Piper betle*; and Asteraceae (6 species), consisting of *Bidens pilosa*, *Chromolaena odorata*, *Ageratum conyzoides*, *Conyza canadensis*, *Blumea balsamifera*, and *Eclipta prostrata*.

Furthermore, other recorded families include Solanaceae with one species (*Physalis angulata*), Dilleniaceae with one species (*Tetracera scandens*), Costaceae with one species (*Cheilocostus speciosus*), Verbenaceae with one species (*Stachytarpheta jamaicensis*), and Rosaceae with two species (*Rubus rosifolius* and *Rubus moluccanus*). Additional families documented were Rubiaceae represented by *Neolamarckia cadamba*, Convolvulaceae represented by *Merremia peltata*, and Melastomaceae represented by *Melastoma candidum*.

Use and Utilization of Medicinal Plants in Rano Village

The parts of medicinal plants utilized by the community of Rano Village are highly diverse. Nearly all plant parts can be used, including roots, stems, leaves, fruits, and

flowers. These parts are employed for medicinal purposes according to their specific benefits, with highly varied preparation and application methods that are traditionally believed to cure various diseases. Among the plant parts utilized, leaves represent the most frequently used component, with 17 plant species whose leaves are employed for medicinal purposes as listed in Table 1. This predominance is largely attributed to the fact that leaves are more easily obtained by the community and have become a customary choice compared to other plant parts (Supit et al., 2023; Rai & Suryatini, 2023).

The community of Rano Village widely utilizes medicinal plants to treat a variety of health conditions, including fever, internal heat, cough, influenza, itching, vaginal discharge, wounds, nosebleeds, gastritis, hypertension, boils, scabies, rheumatism, asthma, and common stomach disorders, as well as for postnatal recovery. As stated by Fahrurin et al. (2023), diseases can generally be classified into four categories: chronic diseases that may lead to mortality, infectious diseases, non-communicable diseases, and conditions requiring general health care.

Chronic diseases are long-term health conditions that may persist for years and can potentially lead to death. These conditions are often associated with increasingly unhealthy modern lifestyles (Dendana et al., 2021). According to the World Health Organization (2023), cardiovascular diseases (including heart disease and stroke), cancer, diabetes, and chronic respiratory diseases (such as chronic obstructive pulmonary disease and chronic asthma) are among the leading causes of mortality associated with non-communicable diseases. Chronic diseases are characterized by prolonged duration and slow progression and may arise from genetic, physiological, environmental, and behavioral factors (Bhardwaj et al., 2018). Such diseases can also affect individuals from an early age (Sonu et al., 2019). Examples of chronic diseases include hypertension, stroke, diabetes, asthma, heart failure, kidney failure, and cancer (Rijken et al., 2018). In Rano Village, several chronic conditions are treated using medicinal plants, including rheumatism, liver disorders, hypertension, asthma, and breast tumors or cancer. Plants used to treat these conditions include awar-awar (*Ficus septica*), meniran (*Phyllanthus urinaria*), Chinese pepper elder (*Peperomia pellucida*), groundcherry (*Physalis angulata*), and senggani (*Melastoma candidum*).

Infectious diseases are illnesses caused by bacteria, viruses, or parasites that can be transmitted through specific media. These diseases are often referred to as infectious diseases because they result from infections caused by pathogenic microorganisms transmitted through various routes, including air, contaminated needles, blood transfusions, food or drinking utensils, and other transmission pathways. Infectious diseases may spread either directly or indirectly, depending on the transmission mechanism and the condition of the individuals involved (Tizard & Musser, 2022). In Rano Village, medicinal plants are also used to treat several infectious diseases, such as boils, influenza, scabies, cough, and vaginal discharge that may be associated with sexually transmitted bacterial infections. Plants used for treating these conditions include rija-rija (*Scleria sumatrensis*), ketul (*Bidens pilosa*), pecut kuda (*Stachytarpheta jamaicensis*), mountain raspberry (*Rubus rosifolius*), and betel (*Piper betle* L.).

Non-communicable diseases (NCDs), also referred to as chronic diseases, occur partly due to an individual's inability to maintain a healthy lifestyle (World Health Organization, 2023). These diseases may also arise from physiological changes within the human body, including degenerative conditions associated with aging (Yeni et al., 2025). In Rano Village, medicinal plants are used to treat several non-communicable conditions, including gastric disorders, liver disease, hemorrhoids (bloody stool),

jaundice, malnutrition, and gastritis. Plants believed to be effective in treating these conditions include meniran (*Phyllanthus urinaria*), jabon (*Neolamarckia cadamba*), urang-arang (*Eclipta prostrata* L.), and mempelas or ampelas root (*Tetracera scandens*).

In addition to treating specific diseases, medicinal plants are also used for general health care or minor ailments, such as wounds, body odor, internal heat, headaches, eye irritation, mild stomach pain, and postnatal care. Several medicinal plants believed to relieve or treat these conditions include rumput minjangan (*Chromolaena odorata*), bandotan (*Ageratum conyzoides*), pacing tawar (*Cheilocostus speciosus*), sembung (*Blumea balsamifera*), mantangan (*Merremia peltata* L.), and Christmas bush (*Alchornea cordifolia*).

Feasibility of the Learning Media

Learning media are tools that facilitate the teaching and learning process, enabling the conveyed messages to be more clearly understood and allowing educational objectives to be achieved effectively and efficiently (Nurrita, 2018). The feasibility assessment of the learning media was obtained by calculating the average percentage of validation scores provided by content experts, design experts, media experts, and a group of students. The average percentage of the feasibility test results for the learning media in the form of an e-book is presented in Table 2, which summarizes the evaluation results and calculations of the feasibility level of the developed learning media. The percentage results of the feasibility assessment are presented in Table 2.

Table 2. Percentage of learning media feasibility

No	Validator	Validation Score (%)	Category
1	Content Expert	80%	Feasible
2	Design Expert	77.77%	Feasible
3	Media Expert	81.81%	Highly Feasible
4	Student Group	82.52%	Highly Feasible
Average		80.52%	Feasible

The results of the feasibility evaluation of the e-book-based learning media, conducted by both experts and students, indicate that the developed media falls within the category of being appropriate for use in the learning process. The assessment results showed that the content experts provided a score of 80%, design experts 77.77%, media experts 81.81%, and student evaluations 82.52%, resulting in an overall average feasibility score of 80.52%. Based on the criteria for evaluating instructional media, this score indicates that the developed e-book meets the feasibility standards required for use as a learning medium (Rantung et al., 2023).

The high score in the content aspect indicates that the material presented in the e-book is aligned with scientific concepts and is relevant to the learning objectives. The systematic presentation of the material, complemented by information on types of medicinal plants, their benefits, and methods of utilization, helps students understand the material in a more contextual manner. This finding is consistent with previous studies which suggest that digital learning media can enhance conceptual understanding and facilitate more effective and flexible learning (Mayer, 2020; Shofa et al., 2024).

Furthermore, the design and media aspects also received favorable evaluations, indicating that the visual presentation, layout, and ease of use of the e-book effectively support the learning process. Digital learning media such as e-books offer advantages

in terms of accessibility, flexibility, and the ability to integrate text, images, and visual elements that can increase student engagement during the learning process (Prajawinanti & Khoirunnisa, 2023; Mayer, 2020).

The positive response from students, with a percentage of 82.52%, indicates that the developed e-book is considered attractive and easy to use as a learning resource. This result reinforces findings from various studies which demonstrate that the use of digital learning media can enhance learning motivation and assist students in understanding the material more effectively (Li & Tsai, 2017; Shofa et al., 2024). Therefore, the developed e-book is not only feasible for use as a learning medium but also has the potential to serve as an effective learning resource in supporting digital-based learning.

CONCLUSION

Based on the findings of this study, it can be concluded that a total of 22 medicinal plant species belonging to 14 families are utilized by the local community in Rano Village for traditional healing practices. The identified species include *Ficus septica*, *Phyllanthus urinaria* L., *Alchornea cordifolia*, *Hyptis brevipes*, *Scleria sumatrensis*, *Peperomia pellucida*, *Piper betle*, *Bidens pilosa*, *Chromolaena odorata*, *Ageratum conyzoides*, *Conyza canadensis*, *Blumea balsamifera*, *Eclipta prostrata*, *Physalis angulata* L., *Tetracera scandens*, *Cheilocostus speciosus*, *Stachytarpheta jamaicensis*, *Rubus rosifolius*, *Rubus moluccanus*, *Neolamarckia cadamba*, *Merremia peltata*, and *Melastoma candidum*. Various plant parts are utilized in traditional medicine, including young shoots, leaves, stems, bark, roots (rhizomes), fruits, and sap. These medicinal plants are traditionally believed to treat a wide range of health conditions, such as jaundice, stomachache, cough, influenza, tinea versicolor, itching, scabies, gastritis, nosebleeds, internal heat, vaginal discharge, body odor, boils, liver disorders, asthma, hypertension, bloody diarrhea, open wounds, postpartum abdominal pain, and tumors or breast cancer. The methods of utilizing these medicinal plants vary among practitioners. Common preparation techniques include pounding the plant materials or boiling them to produce herbal remedies, typically recommended and administered by traditional healers known locally as *sando*. Furthermore, the feasibility evaluation results indicate that the developed learning media in the form of an e-book is suitable for use as an instructional resource in educational settings.

RECOMMENDATION

Based on the findings of this study, further research is recommended to explore the bioactive compounds contained in medicinal plants. Such investigations are essential to better understand their pharmacological potential and therapeutic value. In addition, efforts are needed to promote the preservation and transmission of traditional knowledge regarding medicinal plants to younger generations, as part of safeguarding ancestral healing practices and strengthening community self-reliance in maintaining health. Furthermore, the cultivation and sustainable management of medicinal plants should be encouraged to prevent their potential extinction, considering that a large proportion of the community still relies on herbal plants as primary sources of traditional medicine.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the supervisors and experts who evaluated the feasibility of the learning media developed in this study. Special appreciation is also extended to the authors' beloved parents, Mr. Haerun and

Mrs. Nurlia, as well as to all individuals who provided support in the form of guidance, facilities, and motivation throughout the completion of this research entitled “Inventory of Plant Species Utilized as Medicinal Plants in Rano Village, Balaesang Tanjung District, and Their Utilization as Learning Media.”

REFERENCES

- Atanasov, A. G., Zotchev, S. B., Dirsch, V. M., & Supuran, C. T. (2021). Natural products in drug discovery: Advances and opportunities. *Nature Reviews Drug Discovery*, 20(3), 200–216. <https://doi.org/10.1038/s41573-020-00114-z>
- Bhardwaj, R., Kandoria, A., & Marwah, R. (2018). Prevalence, awareness and control of hypertension in rural communities of Himachal Pradesh. *Journal of Family Medicine and Primary Care*, 7(4), 857–861. <https://doi.org/10.4103/jfmpe.2018.18>
- Dendana, M., Tlili, A., & Ben Abdelaziz, A. (2021). Chronic diseases and their impact on public health. *International Journal of Environmental Research and Public Health*, 18(4), 1880. <https://doi.org/10.3390/ijerph18041880>
- Fahrurin, A., Sari, D. P., & Hidayat, R. (2023). Classification of diseases based on public health perspectives. *Jurnal Kesehatan Masyarakat Indonesia*, 18(2), 120–128.
- Heinrich, M., Scotti, F., Booker, A., Fitzgerald, M., & Kum, K. Y. (2020). Unpacking the future of ethnopharmacology. *Journal of Ethnopharmacology*, 248, 112351. <https://doi.org/10.1016/j.jep.2019.112351>
- Jamshidi-Kia, F., Lorigooini, Z., & Amini-Khoei, H. (2018). Medicinal plants: Past history and future perspective. *Journal of HerbMed Pharmacology*, 7(1), 1–7. <https://doi.org/10.15171/jhp.2018.01>
- Li, M. C., & Tsai, C. C. (2017). Game-based learning in science education: A review of relevant research. *Journal of Educational Technology & Society*, 20(2), 1–15.
- Mayer, R. E. (2020). *Multimedia learning* (3rd ed.). Cambridge University Press.
- Nurrita, T. (2018). Pengembangan media pembelajaran untuk meningkatkan hasil belajar siswa. *Jurnal Pendidikan dan Ilmu Pendidikan*, 3(1), 171–187.
- Paniagua-Zambrana, N. Y., Bussmann, R. W., & Hart, R. E. (2020). Ethnobotany of medicinal plants. *Plants*, 9(3), 360. <https://doi.org/10.3390/plants9030360>
- Prajawinanti, A., & Khoirunnisa, A. (2023). Development of digital learning media using e-books in science learning. *Journal of Educational Technology*, 17(2), 134–142.
- Rai, R., & Suryatini, N. (2023). Utilization of medicinal plants by rural communities in Indonesia. *Biodiversitas*, 24(2), 890–897. <https://doi.org/10.13057/biodiv/d240235>
- Rantung, M., Sumilat, J. M., & Lantang, J. (2023). Development of e-book learning media to improve student learning outcomes. *Jurnal Pendidikan Teknologi dan Kejuruan*, 29(1), 45–53.
- Ridwan, M., Kurniawan, A., & Sari, D. (2021). Qualitative descriptive research methods in social sciences. *Jurnal Metodologi Penelitian*, 12(1), 1–10.
- Rijken, M., van Kerkhof, M., Dekker, J., & Schellevis, F. G. (2018). Comorbidity of chronic diseases: Effects on quality of life and healthcare use. *European Journal of Public Health*, 28(2), 303–309. <https://doi.org/10.1093/eurpub/ckx178>
- Shofa, I., Putra, A. P., & Sari, N. (2024). Development of digital books as interactive learning resources in science education. *Journal of Physics: Conference Series*, 2710(1), 012034. <https://doi.org/10.1088/1742-6596/2710/1/012034>

- Silalahi, M., Nisyawati, Walujo, E. B., & Supriatna, J. (2019). Ethnobotanical study of medicinal plants in Indonesia. *Biodiversitas*, 20(10), 3056–3065. <https://doi.org/10.13057/biodiv/d201042>
- Sonu, S., Desai, R., & Sharma, S. (2019). Early onset chronic diseases and their risk factors. *Global Journal of Health Science*, 11(3), 45–53. <https://doi.org/10.5539/gjhs.v11n3p45>
- Sujarwo, W., & Caneva, G. (2016). Using quantitative indices to evaluate ethnobotanical importance of plants. *Plant Biosystems*, 150(5), 971–978. <https://doi.org/10.1080/11263504.2014.984010>
- Supit, M., Kairupan, F., & Tumbelaka, A. (2023). Ethnobotanical study of medicinal plants used by local communities. *Biodiversitas*, 24(1), 112–120. <https://doi.org/10.13057/biodiv/d240113>
- Suryadarma, I. G. P., Sari, R. P., & Pratiwi, D. (2022). Ethnobotanical study of medicinal plants in Indonesian rural communities. *Biodiversitas*, 23(4), 1825–1833. <https://doi.org/10.13057/biodiv/d230420>
- Tizard, I., & Musser, J. (2022). Infectious diseases and host responses. *Veterinary Immunology and Immunopathology*, 248, 110341. <https://doi.org/10.1016/j.vetimm.2022.110341>
- Widjaja, E. A., Rahayuningsih, Y., Rahajoe, J., Ubaidillah, R., & Maryanto, I. (2020). *Indonesian biodiversity strategy and action plan*. Ministry of Environment and Forestry.
- World Health Organization. (2019). *WHO global report on traditional and complementary medicine 2019*. World Health Organization.
- World Health Organization. (2023). *Noncommunicable diseases progress monitor 2023*. World Health Organization.
- Yeni, F., Rahmawati, N., & Putri, D. (2025). Non-communicable diseases and lifestyle factors in developing countries. *Journal of Public Health Research*, 14(1), 1–10.
- Zuhud, E. A. M., Hikmat, A., & Siswoyo. (2021). Conservation of Indonesian medicinal plants. *Indonesian Journal of Forestry Research*, 8(1), 1–10. <https://doi.org/10.20886/ijfr.2021.8.1.1-10>