

Interpretation of staining results using sappan wood (*Caesalpinia sappan* L.) as an eosin substitute in hematoxylin eosin staining

*Interpretasi Hasil Pewarnaan Menggunakan Kayu Secang (*Caesalpinia Sappan* L.) Sebagai Pengganti Eosin Pada Pewarnaan Hematoxylin Eosin*

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ABSTRACT

Background: An important stage in histopathological examination is the tissue staining process where the staining technique uses Hematoxylin Eosin. Eosin as a dye component is carcinogenic and poses a risk to health and the environment if used in the long term. Sappan wood containing brazilin has the potential to be developed as a natural alternative to eosin

Objective: This study aims to determine the interpretation of staining results using sappan wood as a substitute for eosin in hematoxylin eosin staining

Methods: This study is an experimental study with an intact Group Comparoson design consisting of two treatment groups, namely staining using eosin and sappan wood. Data analysis was carried out using the Chi square test. This study was conducted at the Barokah Palembang anatomical pathology laboratory on March 16-17, 2025. The population taken was histological tissue preparations in this study werw 32 sampels calculated using the Federer formula.

Results: staining using eosin with 100% very good quality of preparation, for staining using sappan wood the quality of preparation is not good 6.3%, less good 50% and good quality 43.8%. The results of the statistical test obtained $p = 0.000 < 0.05$ this indicates a significant difference between the results of staining using eosin and sappan wood filtrate

Conclusion: Sappan wood staining has the potential as a natural dye to replace eosin in Hematoxylin-Eosin staining.

Keywords: eosin, hematoxylin eosin, histopatology, sappan wood

ABSTRAK

Latar Belakang: Tahapan penting dalam pemeriksaan histopatologi adalah proses pewarnaan jaringan, dimana teknik pewarnaan menggunakan Hematoxylin Eosin. Eosin sebagai komponen pewarna bersifat karsogenik dan beresiko terhadap kesehatan dan lingkungan jika digunakan dalam jangka panjang. Kayu secang yang mengandung brazilin berpotensi dikembangkan sebagai alternatif alami pengganti eosin.

Tujuan: Penelitian ini bertujuan untuk mengetahui interpretasi hasil pewarnaan menggunakan kayu secang sebagai pengganti eosin pada pewarnaan hematoxylin eosin.

Metode: Penelitian ini merupakan penelitian eksperimental dengan design intact group comparison yang terdiri dari dua kelompok perlakuan yaitu pewarnaan menggunakan eosin dan kayu secang. Analisis data dilakukan menggunakan uji Chi square. Penelitian ini dilakukan di laboratorium patologi anatomi barokah Palembang pada tanggal 16-17 Maret 2025. Populasi yang diambil adalah preparat jaringan histologi yang berada di laboratorium Patologi Anatomi Barokah Palembang, sampel yang digunakan pada penelitian ini berjumlah 32 sampel yang dihitung menggunakan rumus federer.

Hasil: pewarnaan menggunakan eosin dengan kualitas sediaan 100% sangat baik, untuk pewarnaan menggunakan kayu secang kualitas sediaan tidak baik 6,3%, kurang baik 50% dan kualitas baik 43,8%. Hasil uji statistik didapatkan $p = 0,000 < 0,05$ hal ini menandakan adanya perbedaan yang signifikan antara hasil pewarnaan menggunakan eosin dan filtrat kayu secang.

Kesimpulan: Pewarnaan kayu secang memiliki potensi sebagai pewarna alami pengganti eosin pada pewarnaan Hematoxylin-Eosin.

Kata kunci: eosin, histopatologi, hematoxylin-eosin, kayu secang

INTRODUCTION

Cancer is a dangerous non-communicable disease, characterized by uncontrolled growth and division of abnormal cells.¹ Systematic cancer diagnosis begins with a history, physical examination, and supporting tests such as mammography, ultrasound (USG), CT scan, bone scan, and magnetic resonance imaging (MRI). However, histopathology remains the gold standard for confirming a malignant diagnosis.²

Histopathological examination is a very important diagnostic for identifying infectious organisms.³ The stages of histopathological examination consist of pre-analytical, analytical, and post-analytical stages.⁴ One important stage in this process is tissue staining during the analytical stage, which aims to provide visual contrast between cellular components so they can be clearly observed under a microscope.⁵

Hematoxylin-Eosin (HE) staining is the most commonly used routine staining method in histopathology laboratories.⁶ Hematoxylin acts as a basic dye that binds to nucleic acids in the cell nucleus, producing a blue color, while eosin is an acidic dye that stains the cytoplasmic components pink.⁷ However, long-term use of eosin has been reported to have the potential to cause toxic effects, such as irritation to the skin, eyes, or respiratory tract, and poses a risk of environmental pollution if the waste is not managed properly.⁸ Therefore, an alternative dye that is safer and more environmentally friendly is needed to replace eosin in the tissue staining process.⁹

The use of alternatives to eosin is being done to reduce risks to health and the environment, one way being to find substitutes for eosin.¹⁰ Mamay's research has shown that several natural ingredients, such as sappan wood extract (*Caesalpinia sappan* L.), can be used as eosin substitutes in the dyeing process.¹¹ Sappan wood is a medicinal herb used as a traditional medicine, as well as as a textile and food dye. Its main pigment, brazilin, produces a reddish-yellow color at pH 2–5 and binds to positively charged proteins in the cytoplasm and connective tissue.¹² Brazilin has the potential to be a natural dye to replace eosin and Giemsa in staining worm eggs.¹³ Although it is safe and has the potential to support health,¹⁴ Brazilin has a weakness, namely low color stability against pH changes.¹⁵

Previous research has shown that sappan extract can be used as a natural dye in identifying soil-transmitted helminth (STH) eggs, as the shell structure and egg contents are more clearly visible.¹⁶ Sappan lignum extract contains brazilin as the main compound, as well as flavonoids, lignin, steroids, triterpenoids, and diterpenoids. The red color produced by this extract has the potential to replace the use of 2% eosin in microscopic staining.¹⁷

Previous research conducted by Bose S (2022) found that staining using turmeric and hibiscus water derived from the rhizome of *Curcuma longa* and the petals of *Hibiscus rosa-sinensis* can be used as an alternative to eosin in staining cytoplasm. In this study, statistical analysis was performed to compare six parameters between turmeric and hibiscus. The results showed no significant difference.¹⁸

The potential of sappan wood (*Caesalpinia sappan* L.) extract as an alternative to eosin in hematoxylin–eosin staining was evaluated based on the characteristics of the tissue staining results. The brazilin and brazilin compounds in sappan wood are known to produce red to purplish red colors and have an affinity for certain tissue components, thus potentially being used as a natural dye in histological examinations.

METHODS

Study design

An experimental approach was used to evaluate the interpretation of staining results using sappan wood extract (*Caesalpinia sappan* L.) as a substitute for eosin in Hematoxylin–Eosin staining. The study was conducted from March 1–30, 2025, at the Barokah Anatomical Pathology Specialist Clinical Laboratory, Palembang.

Data source and sampling procedure

The study population was histological tissue preparations at the Barokah Palembang Anatomical Pathology Laboratory. The sampling technique used nonprobability sampling in the form of purposive sampling, namely determining samples based on certain considerations.¹⁹ The sample consisted of 32 mammary tissue preparations with codes S1–16 for the sappanwood group and E1–16 for the eosin group, which met the inclusion criteria in the form of good tissue condition and appropriate sappanwood material quality.

Variables of the study

The research variables consist of independent variables in the form of the use of sappanwood extract as an alternative dye and dependent variables in the form of the results of tissue staining interpretation in the Hematoxylin–Eosin method. The data collection method used is primary data. The tools and materials used are sappanwood flowers, analytical scales, hot plates, filter paper, distilled water, water bath, hematoxylin eosin staining.

Measurement and instruments

The tools and materials used include sappanwood flowers, analytical scales, hot plates, filter paper, distilled water, water baths, and Hematoxylin–Eosin staining reagents.²⁰ The procedure for making sappanwood filtrate is carried out by washing and drying the sappanwood, then boiling 100 grams of sappanwood in 1000 mL of distilled water at 70°C for 21 minutes. The extraction results are cooled to room temperature ($\pm 27^\circ\text{C}$), then filtered using filter paper and stored in a brown bottle as a reagent.¹¹ The hematoxylin–eosin staining procedure begins with immersing the tissue in xylene for 5 minutes three times. Next, the tissue is drained and then immersed in ethanol for 3 minutes with two repetitions, followed by 96% alcohol for 3 minutes twice. After that, the tissue is washed with running water for 3 minutes, immersed in hematoxylin for 5–7 minutes, then washed again using running water for 3 minutes. The hematoxylin staining process is repeated (5–7 minutes), then washed again with running water for 5 minutes. The next stage, the tissue is dipped in 70% alcohol 7 times, then in 80% alcohol 7 times, then in sappanwood filtrate 1–2 times. After that, the tissue is dipped in 96% alcohol 7 times with two repetitions, continued in 100% ethanol 7 times, and finally with immersion in xylene 7 times.²¹

Data collection

The data used are primary data obtained through direct observation of the results of staining tissue preparations that have been processed using sappanwood and eosin.

Ethical considerations

This research has obtained ethical approval with number 000486/KEP IKesT Muhammadiyah Palembang/2025 and was carried out in accordance with research ethics principles.

Data analysis

The collected data was then processed using the Chi-Square statistical test to determine the relationship or difference between the two observed variables. The results of the analysis of each observed indicator were first accumulated in the form of a percentage (%) as the result value. Interpretation of the test results is based on the significance value (Asymp. Sig.). If the Asymp. Sig. value is <0.05 , then H_0 is rejected, which means there is a significant difference between the two variables being tested. Conversely, if the Asymp. Sig. value is >0.05 , then H_0 is accepted, which indicates that there is no significant difference between the two observed variables.

RESULT

The results of tissue quality in staining using eosin obtained the interpretation of the results made by the anatomical pathology expert in Figure 1 as follows:

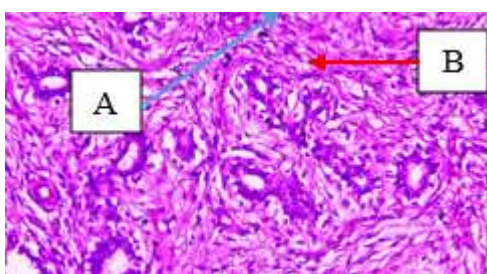


Figure 1. Results of Microscopic Observation of Staining Using Eosin at 400x Magnification

Based on Figure 1, the microscopic results of sample no. 3 were obtained with very good criteria (score 4) in code (A) the cell nucleus appears very clearly blue, code (B) the cytoplasm appears very clearly red, the contrast against the background is very clear and the results of the smear preparation are very uniform.²¹

The results of tissue quality in sappan wood filtrate staining are interpreted based on observations made by an anatomical pathology expert in Figure 2 as follows:

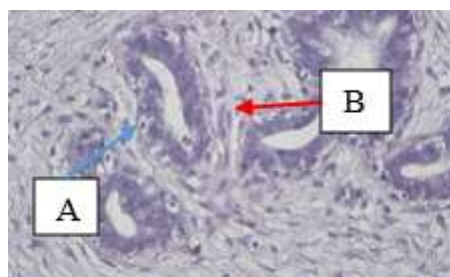


Figure 2. Results of Microscopic Observations of Coloring Using Sappan Wood at 400x Magnification

Based on Figure 2, the microscopic results of sample no. 9 were obtained with good criteria (score 3) in code (A) the cell nucleus was clearly visible in blue, code (B) the cytoplasm was clearly visible in red, the contrast against the background was clearly visible, and the smear results of the preparation were uniform

Based on table 1, it shows that in the staining process using eosin, 16 preparations were obtained with very good criteria, and staining using sappan wood filtrate produced 1 preparation with poor criteria, 8 preparations with fair criteria, and 7 preparations with good criteria.

Table 1. Coloring Tabulation Results

Eosin Sample	Check up result		Sample of Sappan Wood	Check up result	
	Coloring	Score		Coloring	Skor
E1	Very good	4	S1	Good	3
E2	Very good	4	S2	Fair	2
E3	Very good	4	S3	Good	3
E4	Very good	4	S4	Good	3
E5	Very good	4	S5	Fair	2
E6	Very good	4	S6	Fair	2
E7	Very good	4	S7	Good	3
E8	Very good	4	S8	Fair	2
E9	Very good	4	S9	Good	3
E10	Very good	4	S10	Fair	2
E11	Very good	4	S11	Fair	2
E12	Very good	4	S12	Good	3
E13	Very good	4	S13	Poor	1
E14	Very good	4	S14	Fair	2
E15	Very good	4	S15	Fair	2
E16	Very good	4	S16	Good	3

Based on table 1, it shows that in the staining process using eosin, 16 preparations were obtained with very good criteria, and staining using sappan wood filtrate produced 1 preparation with poor criteria, 8 preparations with fair criteria, and 7 preparations with good criteria.

Table 2. Statistical Test Results

Nilai Asymp. Sig (p-value)	Statistical Decision	Interpretasi
< 0,05	H0 is rejected	There is a significant difference between the two variables tested
> 0,05	H0 is accepted	There is no significant difference between the two variables tested.

The collected data was then processed using the Chi-square test. Data on each observed indicator was accumulated into a % (percentage) as the result. Data with a significant result (asymp. Sig.) <0.05 indicates a difference between the two variables, while data with a value >0.05 indicates no difference between the two variables.

**Figure 3. Average Staining Results Diagram Using Eosin and Sappan Wood Filtrate**

Based on the average staining results diagram, there is a clear difference between the use of Eosin staining and Sappan Wood staining in the observation results. In Eosin staining, all observation results show the category "Very Good" with a percentage of 100%, while in the categories "Good", "Fair", and "Poor" no results were found (0%). This shows that Eosin staining provides very optimal and consistent results in providing good staining quality on the samples observed. Conversely, in Sappan Wood staining, there are no results in the category "Very Good" (0%). Most of the results are in the category "Good" at 50%, followed by the category "Fair" at 43.80%, and "Poor" at 6.30%. This data shows that Sappan Wood staining still has variations in the quality of the results and in general has not reached the optimal level like Eosin staining.

DISCUSSION

This study used 32 mammary tissue samples, consisting of 16 preparations stained with eosin and 16 preparations stained with sappanwood filtrate. Microscopic examination results showed that all preparations stained with eosin (16 preparations; 100%) had very good criteria (score 4). Meanwhile, in staining using sappanwood filtrate, 1 preparation (6.3%) was obtained with poor criteria (score 1), 8 preparations (50%) with less good criteria (score 2), and 7 preparations (43.8%) with good criteria (score 3).

The results of statistical tests showed a significant difference between the quality of staining using eosin and sappanwood, so that the sappanwood dye formulation could not match the effectiveness of eosin in staining histological tissue. The results of microscopic examination showed that all preparations (100%) stained with eosin had very good quality (score 4), because eosin as a counter dye produced a pink color that stained the cytoplasm.²² Eosin is acidic so basic cell structures, such as the cytoplasm, will bind this dye and appear pink.²³

Microscopic examination results showed that of the 16 preparations stained with sappanwood filtrate, 1 preparation was of poor quality, 8 preparations were of poor quality, and 7 preparations were of good quality. Brasilin in sappanwood is susceptible to degradation during storage and is strongly influenced by pH and temperature. Although high temperatures during extraction can increase color intensity, under certain conditions the color can decrease due to pigment denaturation, thus affecting the quality of the staining.¹⁴

Previous research has shown that the stability of anthocyanin and brazilin compounds is highly dependent on extraction and storage conditions. Anthocyanins are known to experience color degradation during storage, particularly at neutral to alkaline pH, which results in a decrease in color intensity. Optimal coloration occurs under acidic conditions, where anthocyanins produce a more stable red color.²⁴ Other researchers have noted the importance of extraction temperature and solvent type. Too high an extraction temperature can cause degradation of the active compounds, while the solvent type affects the efficiency of pigment extraction. Polar solvents like water tend to produce weaker colors than semipolar solvents like ethanol.²⁵ This is supported by previous research which showed that 96% ethanol-sappan solution provided the best color intensity compared to water solvent.²⁶

This aligns with previous research that found anthocyanin concentration also affects the resulting color. High concentrations produce red, while low concentrations tend to produce purplish-blue. The difference in color intensity in this study may be due to the inconsistent concentration of the filtrate, which has not been consistently standardized.²¹

The results of the study indicate that sappanwood has the potential as a natural dye to replace eosin in Hematoxylin–Eosin staining, but its staining quality is not yet comparable to eosin. Optimization of the filtration and staining process of sappanwood

is needed so that it can become an effective and efficient alternative dye in histopathology. Alternative isolation processes that can produce more concentrated/effective compounds are extraction with appropriate solvents, chromatography, distillation, ultrasonic extraction, and microwave extraction. The selection of the appropriate isolation process depends on the nature of the target compound and the sample matrix, so optimization of the isolation process is needed to obtain optimal results.

This research has the advantage of reducing health and environmental risks by using natural sappanwood dye. However, the dye quality remains low due to factors such as extraction temperature, solvent, pH, heating time, and anthocyanin stability. There are no conflicts of interest in this publication.

CONCLUSION

This study shows that sappanwood has the potential as a natural dye to replace eosin in hematoxylin-eosin staining, but the staining quality still needs to be improved through optimization of the filtration and staining processes. Based on the results of the research that has been conducted, it is recommended that further research can optimize the process of using sappanwood as a natural dye, especially in the filtration and staining stages. This aims to improve the quality of the staining results so that it can approach or match the quality of eosin staining in hematoxylin-eosin staining. In addition, further research is needed regarding variations in the concentration of sappanwood extract, the length of soaking time, and different extraction methods to obtain more optimal and consistent staining results. The development of standard work procedures (SOPs) is also needed so that the use of this natural dye can be applied more widely in the field of histotechnology and anatomical pathology laboratories.

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REFERENCES

1. Nurlita S, Kurrohman T, Dwibarto R. Faktor-faktor yang berhubungan dengan capaian deteksi dini kanker payudara metode SADANIS pada wanita usia subur. *J Penelit Perawat Prof.* 2024;6(4):1575–1586. doi:10.37287/jppp.v6i4.2802.
2. Suparna K, Sari Lmkks. Kanker Payudara: Diagnostik, Faktor Risiko, Dan Stadium. *Ganesha Med.* 2022;2(1):42-48. Doi:10.23887/Gm.V2i1.47032
3. Ayu Fazriah I, Wiryanti W, Durachim A, Sundara MY. Pengaruh ukuran dan arah pemotongan jaringan payudara terhadap kualitas preparat. *J Kesehat Siliwangi.* 2023;4(1):334–339.
4. Intan Sari T, Hasanah S, Arsyad M, Ainur Rahmah N, Suciati Y. Perbedaan Morfologi Kelenjar Mammariae Dan Jaringan Ikat Pada Kanker Payudara Dan Fibrokistik Di Rumah Sakit Islam Jakarta. *Maj Sainstekes.* 2022;9(1):001-008. Doi:10.33476/Ms.V9i1.2650
5. Apriani, Andrianus, Marisca S, Diana P. Ez Prep Concentrate (Ez Prep) Sebagai Alternatif Reagen Deparafinasi Pada Pewarnaan Hematoksilin Eosin. *G-Tech J Teknol Terap.* 2023;7(1):96-102. Doi:10.33379/Gtech.V7i1.1874
6. Siregar S, Krisdianilo V, Rizky Va. Efektifitas Penggunaan Pewarna Alternatif Preparat Permanen Telur Nematoda Usus Menggunakan Pewarna Rhodamin B. *J Farm.* 2019;2(1):31-39. Doi:10.35451/Jfm.V2i1.194

7. Saraswati, Rahmawati Y. Rosella (Hibiscus Sabdariffa) Sebagai Alternatif Bahan Pewarna Histologi. *J Sains Dan Teknol Lab Medis*. 2023;9(1):1-5.
8. Asyah S, Nailufar Y, Astuti Td. Literature Review: Red Dragon Fruit (Hylocereus Costaricensis) As An Alternative Stain To Hematoxylin-Eosin In Histology Preparation Making. *Menara J Heal*. Published Online 2024:220-228. <https://Jurnal.Iakmikus.org/Article/View/189%0ahttps://Jurnal.Iakmikus.org/Article/Download/189/137>
9. Octary N, Sari I, Aristoteles. Liver Tissue Examination Of Mice Using 10% Bnf Fixation For 6 Hours And 16 Hours. *J Anal Lab Med*. 2022;7(2):104-109. Doi:10.51544/Jalm.V7i2.3457
10. Premalatha Br, Patil S, Rao Rs, Indu M. Mineral Oil-A Biofriendly Substitute For Xylene In Deparaffinization: A Novel Method. *J Contemp Dent Pract*. 2013;14(2):281-286. Doi:10.5005/Jp-Journals-10024-1314
11. Mamay, Ernawati, Nurisani A. Potential Of Sappan Wood, Purple Cabbage And Beetroot Extract In Sperm Staining. *Indones J Med Lab Sci Technol*. 2023;5(2):100-111. Doi:10.33086/Ijmlst.V5i2.3961
12. Sukeksi A, Teguh Isworo J, Alvionita D, Putri T. Pengaruh Waktu Pengecatan Menggunakan Ekstrak Kayu Secang (Caesalpinia Sappan) Terhadap Warna Sel Eritrosit Pada Sediaan Apusan Darah Tepi (Sadt). *Pros Semin Nas Unimus*. 2022;5:1482-1489.
13. Shabrina HM, Muntalif BS, Firdayati M, Fathuna IS. Deteksi dan kuantifikasi telur cacing *Ascaris* spp. pada air limbah dan lumpur IPAL Bojongsoang Bandung. *J Sains Teknol Lingkung*. 2021;13(1):62–75.
14. Irawan Ew, Sipahelut Sg, Mailoa M. Potensi Ekstrak Kayu Secang (Caesalpinia Sappan L.) Sebagai Pewarna Alami Dalam Pembuatan Selai Pala (*Myristica Fragrans* H.). *J Teknol Has Pertan*. 2022;15(1):74-82. Doi:10.20961/Jthp.V15i1.58031
15. Khoirul M, Rahayuningsih E, Mindaryani Am. Pemanfaatan Larutan Kayu Secang (Caesalpinia Sappan L.) Sebagai Counterstain Pada Pengecatan Gram *Escherichia Coli* Atcc 25922. *J Rekayasa Proses*. 2023;17(1):1-11. Doi:10.22146/Jrekpros.82068
16. Nurhidayanti N, Permana O. Perbandingan Pemeriksaan Tinja Metode Sedimentasi Dengan Metode Natif Dalam Mendeteksi Soil Transmitted Helminth. *J Anal Lab Med*. 2021;6(2):57-66. Doi:10.51544/Jalm.V6i2.2000
17. Munawaroh S, Shofi M. Modifikasi pewarna alami ekstrak etanol Sappan lignum pada pewarnaan Soil-Transmitted Helminth pengganti eosin 2%. *Bioscientist*. 2023;11(2):1553–1562. doi:10.33394/bioscientist.v11i2.9245.
18. Bose S, Sharma M, Karthikeyan R, Kumar M, Chawla G, Tyagi V. Histopathological Correlative Assessment Of Cytoplasmic Staining By Aqueous Extracts Of Hibiscus And Turmeric With Eosin On 70 Tissue Samples. *Int J Health Sci (Qassim)*. 2022;6(April):3915-3925. Doi:10.53730/Ijhs.V6ns3.6652
19. Sari I. Pemanfaatan minyak wortel yang ramah lingkungan sebagai pengganti xylol dalam proses deparafinisasi. *Masker Medika*. 2024;12(2):364–370. doi:10.52523/maskermedika.v12i2.682.
20. Indah, Sukron, Merdaliani R, Butar-Butar VD, Rizqillah CA. Deparafinisasi pada pewarnaan hematoksin eosin. Get Press Indonesia; 2025. 72 hlm.
21. Haliza N, Sari I, Hartati D, Kurniawati NF. Pemanfaatan ekstrak bunga asoka sebagai alternatif eosin pada pewarnaan hematoksin. *J Ris Kesehat Poltekkes Depkes Bandung*. 2025;17(1):100–106.
22. Rahmawati F, Purwaning Sari K, Huda N, Rousdy Dw. Ekstrak Biji Kesumba Keling (*Bixa Orellana* L.) Sebagai Pewarna Alami Sediaan Jaringan Ikan Nila (*Oreochromis Niloticus*). *J Bios Logos*. 2023;13(3):233-242. Doi:10.35799/Jbl.V13i3.51905

23. Darmadi D, Dikna J. Morfologi Telur Ascaris Lumbricoides Dengan Menggunakan Pewarnaan Hematoksilin Eosin. *Borneo J Med Lab Technol.* 2022;5(1):335-340. Doi:10.33084/Bjmlt.V5i1.4433
24. Permatasari R, Suriani E, Chania P. Potensi Daun Miana (*Plectranthus Scutellaroides*) Sebagai Pewarna Alternatif Pengganti Eosin Dalam Pemeriksaan Telur Cacing Soil Transmitted Helminth (Sth). *Pros Semin Kesehat Perintis.* 2021;4(2):30-36.
25. Fauziyah R, Widyasanti A, Rosalinda S. Perbedaan metode ekstraksi terhadap kadar sisa pelarut dan rendemen total ekstrak bunga telang (*Clitoria ternatea L.*). *Kimia Padjadjaran.* 2022;1(1):18–25.
26. Sita SNF, Prabandari R, Kusuma IY. Pengaruh variasi konsentrasi gliserin sebagai humektan terhadap stabilitas sediaan pasta gigi ekstrak etanol daun salam (*Syzygium polyanthum* (Wight) Walp). *Pharmacy Genius.* 2022;1(1):27–34. doi:10.56359/pharmgen.v1i01.147.