

DAFTAR PUSTAKA

- Bose, S., Hochella Jr, M. F., Gorby, Y. A., Kennedy, D. W., McCready, D. E., Madden, A. S., dan Lower, B. H. 2009. Bioreduction of Hematite Nanoparticles By The Dissimilatory Iron Reducing Bacterium *Shewanella oneidensis* MR-1. *Geochimica et Cosmochimica Acta*. 73(4): 962-976. DOI: [10.1016/j.gca.2008.11.031](https://doi.org/10.1016/j.gca.2008.11.031)
- Cahyadi, A. 2016. Peran Telaga dalam Pemenuhan Kebutuhan Air Kawasan Karst Gunungsewu Pasca Pembangunan Jaringan Air Bersih. *Geo Media: Majalah Ilmiah dan Informasi Kegeografian*. 14(2). DOI: [10.21831/gm.v14i2.13813](https://doi.org/10.21831/gm.v14i2.13813)
- Djasfar, S. P., dan Pradika, Y. 2023. Identifikasi Bakteri Penyebab Infeksi Nosokomial (*Pseudomonas aeruginosa*) pada Lantai Intensive Care Unit (ICU). *Jurnal Medical Laboratory*. 2(1): 9-19. DOI: <https://doi.org/10.57213/medlab.v2i1.135>
- Dwi, N. R. A., Mulia, D. S., Suwarsito, S., dan Purbomartono, C. 2023. Isolasi, Karakterisasi, dan Identifikasi Bakteri *Aeromonas* sp. pada Lele (*Clarias* sp.) di Kabupaten Banyumas, Jawa Tengah. *Sainteks*. 20(2): 189-204. DOI: [10.30595/sainteks.v20i2.19557](https://doi.org/10.30595/sainteks.v20i2.19557)
- Ebrahiminezhad, A., Manafi, Z., Berenjjan, A., Kianpour, S., dan Ghasemi, Y. 2017. Iron-Reducing Bacteria and Iron Nanostructures. *Journal of Advanced Medical Sciences and Applied Technologies*. 3(1). 9-16. DOI: [10.18869/NRIP.JAMSAT.3.1.9](https://doi.org/10.18869/NRIP.JAMSAT.3.1.9)
- Faisal. 2023. Isolasi dan Identifikasi Bakteri Karbonoklastik Penyebab Kerusakan Lukisan Prasejarah di Kawasan Karst Maros Pangkep. *Skrripsi*. Universitas Hasanuddin.
- Falah, M. D dan Tabbu, M. A. S. 2023. Zonasi Kawasan Karst Untuk Pengembangan Wilayah Daerah Waenunge Kabupaten Barru. *Indonesian Journal of Fundamental and Applied Geography*. 34-49. DOI: <https://doi.org/10.35580/jes.v6i1.53692>
- Febria, F. A., & Rahman Saputra, N. N. 2015. Bakteri Pada Ornamen Gua Baba Sumatera Barat Yang Memiliki Aktivitas Urease Sebagai Dasar Kajian Biogrouting. *SEMIRATA*: 4(1).
- González, I., Laiz, L., Hermosin, B., Caballero, B., Incerti, C., dan Sáiz-Jiménez, C. 1999. Bacteria Isolatd From Rock Art Paintings: The Case of Atlanterra Shelter (South Spain). *Journal of Microbiological Methods*. 36 (2): 123-127. DOI: [10.1016/S0167-7012\(99\)00017-2](https://doi.org/10.1016/S0167-7012(99)00017-2)
- ..., Ambeng, A., Yusriana, Y., Priosambodo, D., Lebe, R. 2024. Communities on Degraded Prehistoric Rock Paintings in Maros-Bal Geopark. *Philippine Journal of Science*. 153 (1): 391-402.
- ..., A., dan Permana, R. C. E. 2020. Identifikasi Penyebab Biologis Gambar Cadas Gua Prasejarah Maros, Sulawesi



Selatan. *Borobudur*. 14(1): 22-37. DOI: <https://doi.org/10.33374/jurnalkonservasicagarbudaya.v14i1.229>

Hersman, L., Maurice, P., dan Sposito, G. 1996. Iron Acquisition From Hydrous Fe (III)-Oxides by An Aerobic *Pseudomonas* sp. *Chemical Geology*. 132(1-4): 25-31. DOI: [https://doi.org/10.1016/S0009-2541\(96\)00038-1](https://doi.org/10.1016/S0009-2541(96)00038-1)

Hersman, L. E., Forsythe, J. H., Ticknor, L. O., dan Maurice, P. A. 2001. Growth of *Pseudomonas mendocina* on Fe (III) (hydr)oxides. *Applied and Environmental Microbiology*. 67(10): 4448-4453. DOI: [10.1128/AEM.67.10.4448-4453.2001](https://doi.org/10.1128/AEM.67.10.4448-4453.2001)

Ilmi, M. M., Maryanti, E., Nurdini, N., Lebe, R., Oktaviana, A. A., Burhan, B., dan Kadja, G. T. 2023. Uncovering the Chemistry of Color Change in Rock Art in Leang Tedongnge (Pangkep Regency, South Sulawesi, Indonesia). *Journal of Archaeological Science: Reports*. 48: 103871. DOI: [10.1016/j.jasrep.2023.103871](https://doi.org/10.1016/j.jasrep.2023.103871)

Khatoun, H., Anokhe, A., dan Kalia, V. 2022. Catalase Test: A Biochemical Protocol for Bacterial Identification. *AgriCos e-Newsletter*. 3(1): 53-55.

Koznik-Kwaśnicka, K., Golec, P., Jaroszewicz, W., Lubomska, D., dan Piechowicz, L. 2022. Into the Unknown: Microbial Communities In Caves, Their Role, and Potential Use. *Microorganisms*. 10(2): 222. DOI: [10.3390/microorganisms10020222](https://doi.org/10.3390/microorganisms10020222)

Kshikhundo, R., dan Itumhelo, S. 2016. Bacterial Species Identification. *World News of Natural Sciences*. 3.

Laiz, L., Hermosin, B., Caballero, B., dan Saiz-Jimenez, C. 2000. Bacteria Isolatd From The Rocks Supporting Prehistoric Paintings in Two Shelters From Sierra de Cazorla, Jaen, Spain. *Aerobiologia*. 16: 119-124. DOI: [10.1023/A:1007684904350](https://doi.org/10.1023/A:1007684904350)

MacDonald, B. L., Stalla, D., He, X., Rahemtulla, F., Emerson, D., Dube, P. A., dan White, T. A. 2019. Hunter-Gatherers Harvested And Heated Microbial Biogenic Iron Oxides To Produce Rock Art Pigment. *Scientific Reports*. 9(1): 17070. DOI: [10.1038/s41598-019-53564-w](https://doi.org/10.1038/s41598-019-53564-w)

Magetanapuang, D., Anggraeni, N. S., Mucharam, A., Haryandi, K., dan Rico, W. 2023. Perancangan Media Kampanye Pelestarian Kawasan Karst Maros-Pangkep Sebagai Media Edukasi Publik. *Commed Jurnal Komunikasi dan Media*. 7(2): 156-175. DOI: <https://doi.org/10.33884/commed.v7i2.7568>

Mulyadi, Y. 2016. Kajian Keterawatan Lukisan Gua Prasejarah Di Kawasan Karst Maros-Pangkep Sulawesi Selatan. *Borobudur*. 10(1). 15-27. DOI: <https://doi.org/10.33374/jurnalkonservasicagarbudaya.v10i1.144>

23. Identifikasi Fasilitas Geopark Stone Garden. In Bandung Series: *Urban & Regional Planning*. 3(2). DOI: [10.29313/bcsurp.v3i2.8502](https://doi.org/10.29313/bcsurp.v3i2.8502)

dan Horman, J. R. 2021. Calculation Of Limestone Volume Using Method: Perhitungan Volume Batugamping Menggunakan



Metode Penampang. *Intan Jurnal Penelitian Tambang*. 4(2): 73-78. DOI: <https://doi.org/10.56139/intan.v4i2.85>

Nazla, C. T. F. 2022. Bioremediasi Besi (Fe) Oleh Bacillus sp. Dari Sedimen Sungai Krueng Aceh. *Doctoral Dissertation*. Universitas Islam Negeri Ar-Raniry. Banda Aceh

Nuhung, S. 2016. Karst Maros Pangkep menuju Geopark Dunia (Tinjauan Dari Aspek Geologi Lingkungan). *Plano Madani: Jurnal Perencanaan Wilayah dan Kota*. 5(1): 1-7. DOI: <https://doi.org/10.24252/jpm.v5i1.977>

Paray, A. A., Singh, M., dan Amin Mir, M. 2023. Gram staining: A Brief review. *International Journal of Research and Review*. 10(9): 336-341. DOI: [10.52403/ijrr.20230934](https://doi.org/10.52403/ijrr.20230934)

Permana, R. C. E. 2021. Tradisi Gambar Tangan Gua Prasejarah. *Jurnal Seni Nasional Cikini*. 7(2): 129-138. DOI: <https://doi.org/10.52969/jsnc.v7i2.139>

Purnaweni, H. 2014. Kebijakan Pengelolaan Lingkungan di Kawasan Kendeng Utara Provinsi Jawa Tengah. *Jurnal Ilmu Lingkungan*. 12(1): 53-65. DOI: <https://doi.org/10.14710/jil.12.1.53-65>

Rahma, R., Yusiana, L. S., dan Gunadi, I. G. A. 2020. Perencanaan Kawasan Karst Sebagai Kawasan Geowisata Di Kabupaten Grobogan, Jawa Tengah. *Jurnal Arsitektur Lansekap*. 6(2): 149-159. DOI: [10.24843/JAL.2020.v06.i02.p02](https://doi.org/10.24843/JAL.2020.v06.i02.p02)

Rifai, K. R. 2021. Uji Indole Sebagai Kegiatan Penjaminan Mutu Tambahan Pada Hasil Pengujian Coliform Dalam Sampel Air Mineral. *Indonesian Journal of Industrial Research*. 6(1): 1-6. DOI: [10.36048/jtpii.v6i1.6670](https://doi.org/10.36048/jtpii.v6i1.6670)

Sahrina, A., Safitri, F. D., Withuda, F. A., Satriyo, A., dan Gabriele, M. T. 2022. Use of Karst Caves in Malang Regency and the Possible Challenges to Their Existence. *KnE Social Sciences*: 438-449. DOI: <https://doi.org/10.18502/kss.v7i16.12187>

Salsabila, A. 2023. Pengaruh Perlakuan Biochar Sekam Padi dan Sedimen Bakau Terhadap Penurunan Logam Berat Besi (Fe) dan Sulfat pada Limbah Air Asam Tambang. *Skripsi*. Universitas Hasanuddin.

Sanjaya, Z. W., Mahtuti, E. Y., & Widhaningrum, S. N. 2023. Gambaran Bakteri Gram Negatif Pada Limbah Cair Laboratorium Klinik STIKes Maharani Malang. *Anakes: Jurnal Ilmiah Analisis Kesehatan*. 9(2): 224-231. DOI: <https://doi.org/10.37012/anakes.v9i2.1578>

Sucahyo, A. I., Manalu, K., & Nasution, R. A. 2023. Isolasi dan Identifikasi Mikroba Kontaminasi dari Udara di Laboratorium Kultur Jaringan UIN-SU Medan. *Jurnal Biologi*. 1(1): 1-12. DOI: <https://doi.org/10.47134/biology.v1i1.1931>

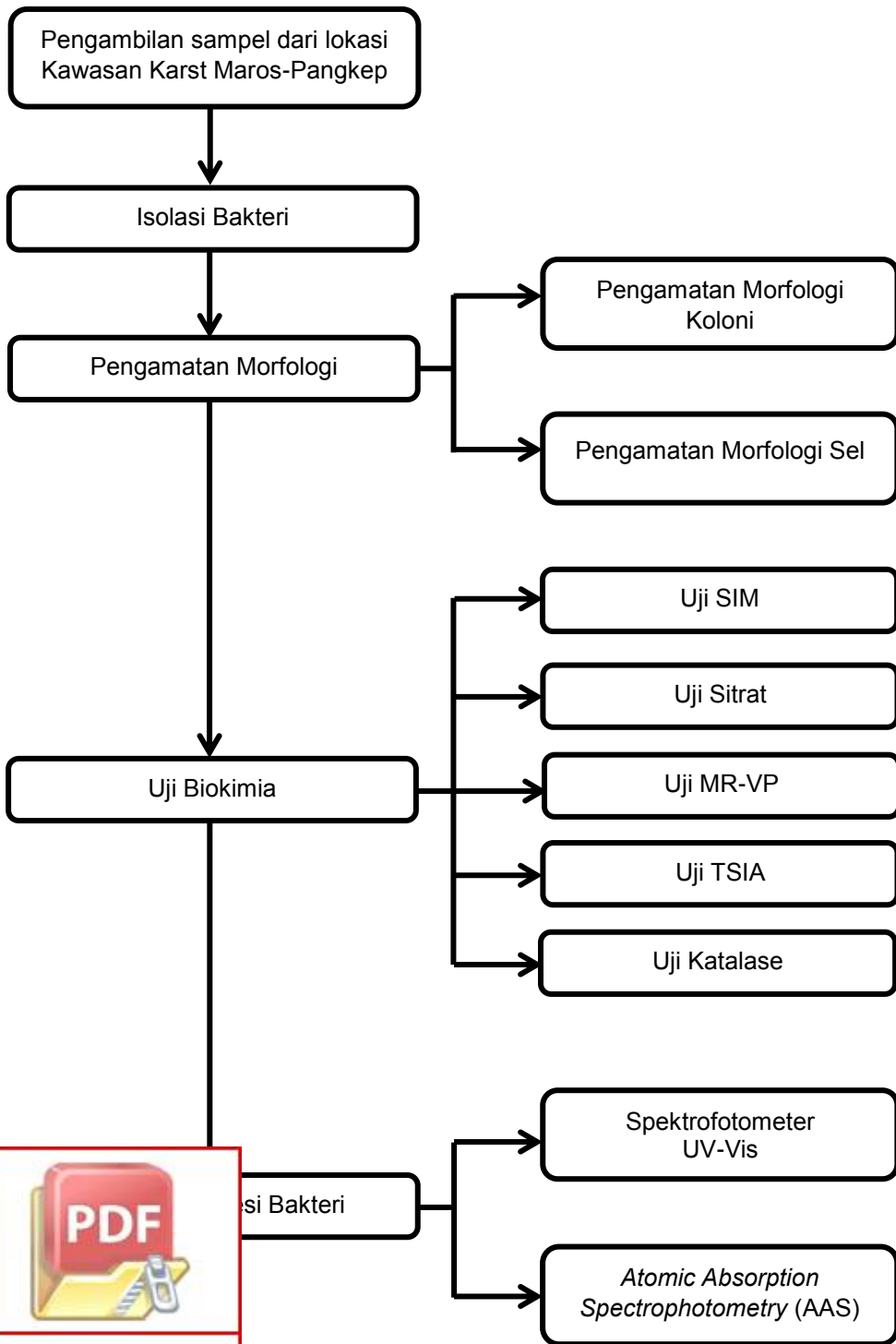
Faktor-Faktor Penyebab Kerusakan Lukisan Gua Prasejarah Pangkep dan Upaya Penanganannya. *Borobudur*. 6(1):14-25. DOI: <https://doi.org/10.24060/borobudur.v6i1.4083>



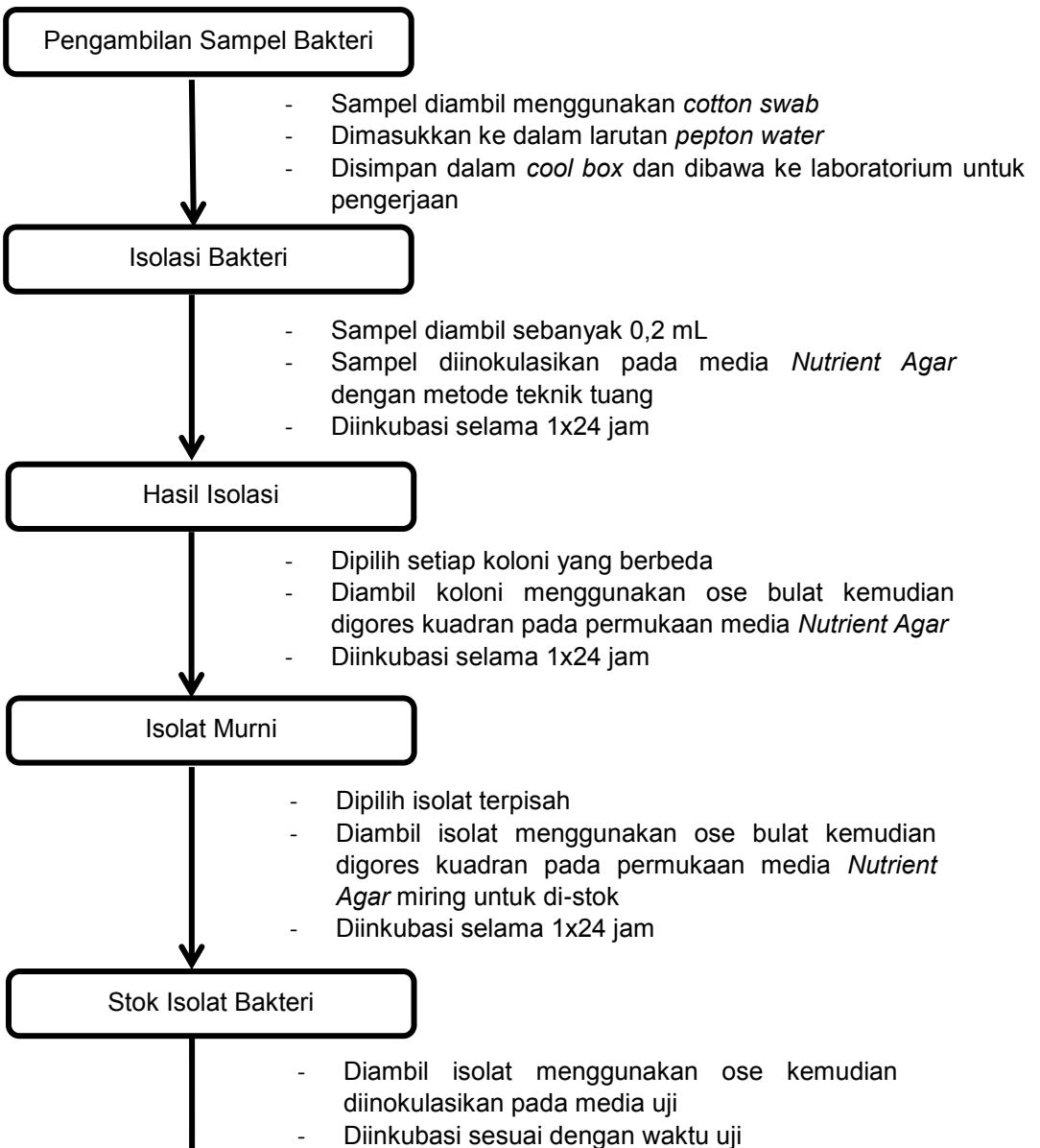
- Suhartono, Y. 2015. Penggunaan Bahan Alami Pada Bahan Restorasi Lukisan Gua Prasejarah Maros Pangkep (Sulawesi Selatan). *Borobudur*. 9(1): 62-71. DOI: <https://doi.org/10.33374/jurnalkonservasicagarbudaya.v9i1.162>
- Tekin, D., Yörük, S., dan Kocadagistan, E. 2013. Kinetics of Bacterial Reduction of Hematite by *Acidithiobacillus ferrooxidans*-r4A1FC2B3. *Asian Journal of Chemistry*. 25(16): 8875. DOI: [10.14233/ajchem.2013.14877](https://doi.org/10.14233/ajchem.2013.14877)
- Widodo, W., Purlinda, D.E., dan Riadi, A. 2022. Perbandingan Berbagai Metode Pengecatan Spore pada *Bacillus cereus*. *Jurnal Laboratorium Medis*. 4(2): 91-94. DOI: [10.31983/jlm.v4i2.8493](https://doi.org/10.31983/jlm.v4i2.8493)
- Windy, W., & Dewi, L. 2023. Detection of Lactic Acid Bacteria (LAB) In Soaking Water of Arabica Coffee Cherries on Mount Sindoro. *Journal of World Science*. 2(9): 1375-1386. DOI: [10.58344/jws.v2i9.409](https://doi.org/10.58344/jws.v2i9.409)
- Yusriana, Y., Muda, K. T., dan Susanti, D. 2020. Keterancaman Lukisan Dinding Gua Prasejarah Bulu Sipong di Kabupaten Pangkep Sulawesi Selatan. *Asian Journal of Environment, History and Heritage*. 4(2).
- Zerboni, A., Villa, F., Wu, Y. L., Solomon, T., Trentini, A., Rizzi, A., dan Gallinaro, M. 2022. The Sustainability of Rock Art: Preservation and Research. *Sustainability*. 14(10): 6305. DOI: <https://doi.org/10.3390/su14106305>



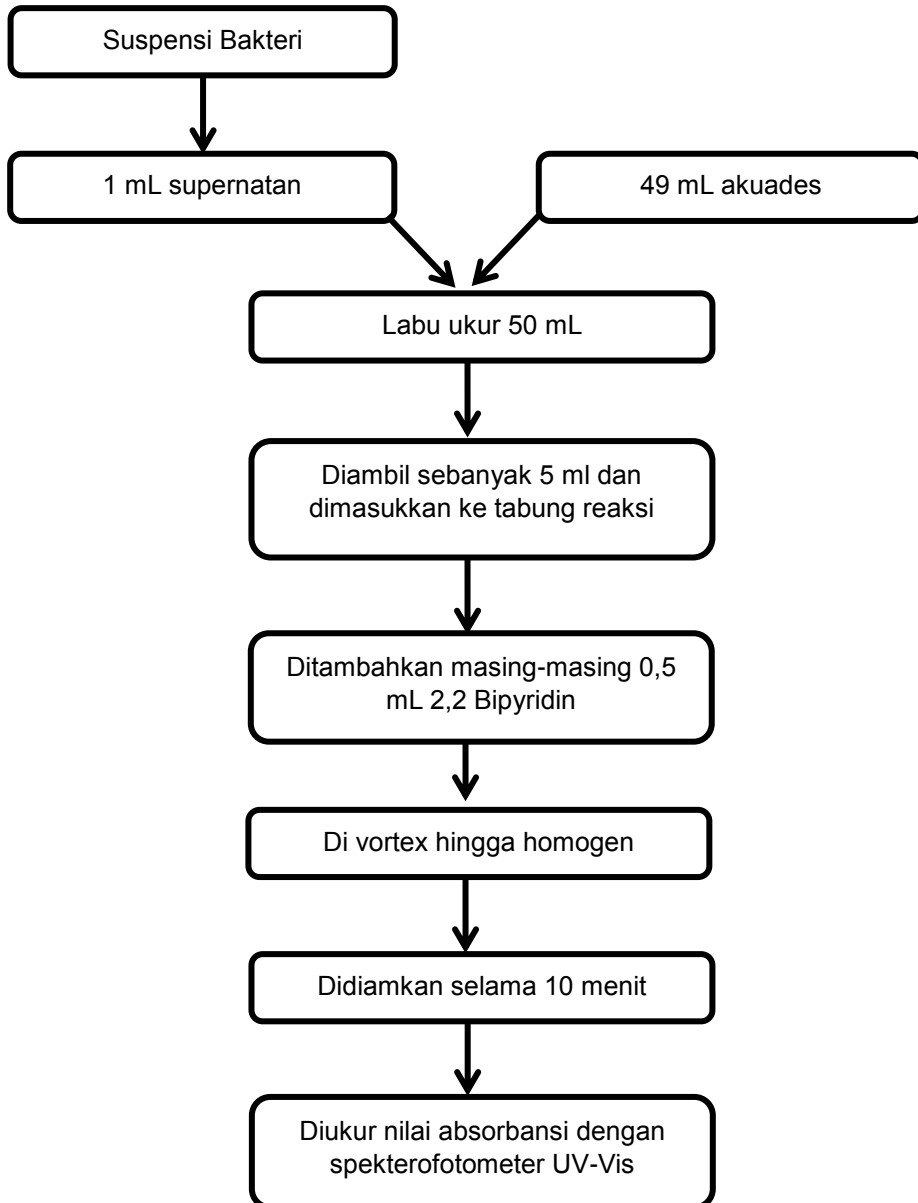
Lampiran 1. Skema Kerja Penelitian



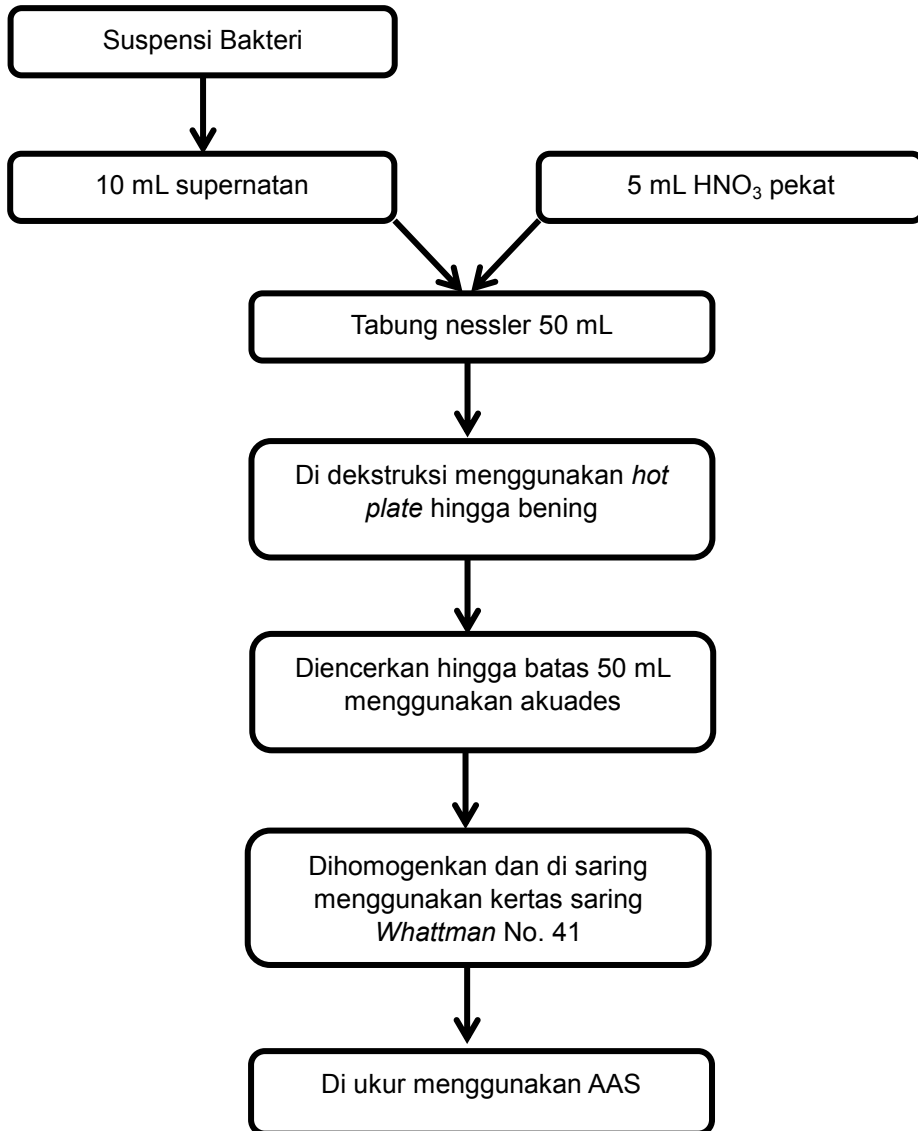
Lampiran 2. Skema Kerja Pengambilan Sampel, Isolasi dan Uji Biokimia Bakteri Pereduksi Besi



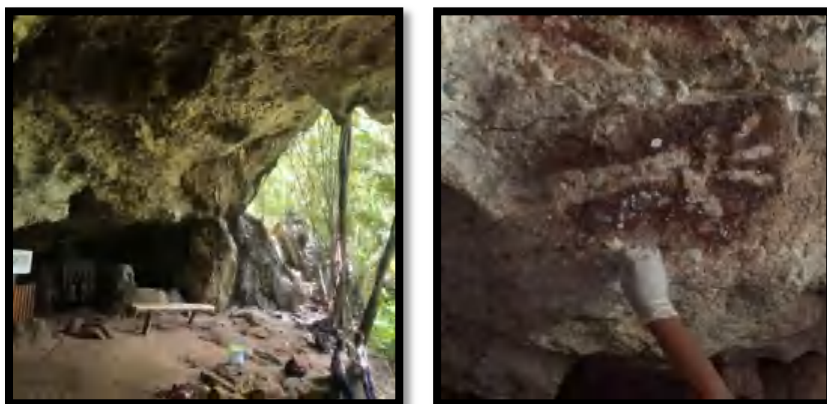
Lampiran 3. Skema Kerja Uji Reduksi Besi oleh Bakteri menggunakan Spektrofotometer UV-Vis



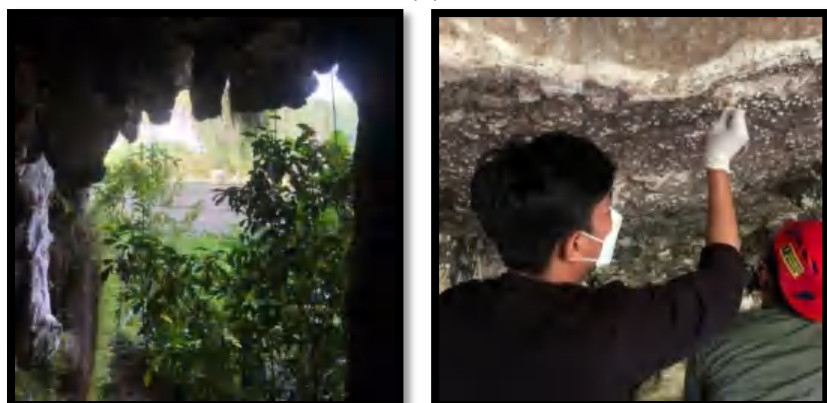
Lampiran 4. Skema Kerja Uji Reduksi Besi oleh Bakteri menggunakan *Atomic Absorption Spektrofotometer (AAS)*



Lampiran 5. Tempat Pengambilan Sampel



(a)



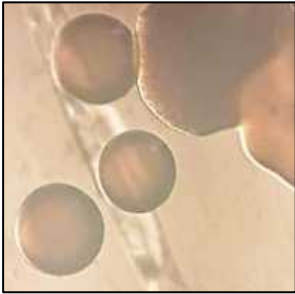
(b)



(c)

sampel (a) gua Sumpang Bitu, (b) gua Leang Timpuseng, dan (c) gua Leang Pettae

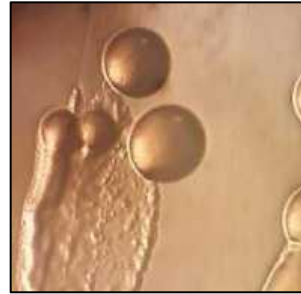


Lampiran 7. Hasil Pengamatan Morfologi Koloni

SPB-1b



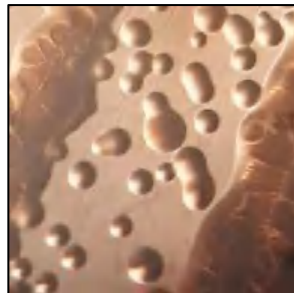
SPB-2a



SPB-2b



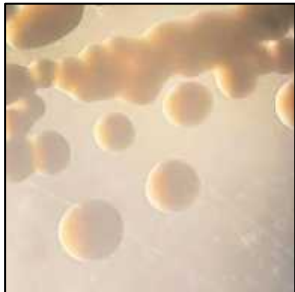
SPB-5a



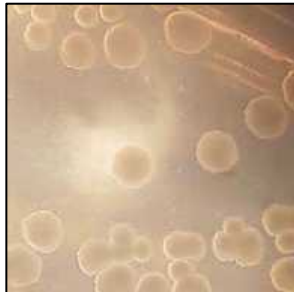
SPB-5b



SPB-7a



LTP-2a



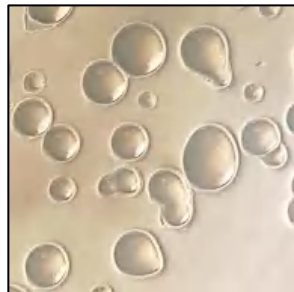
LTP-3a



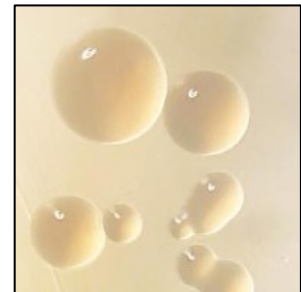
LTP-6a



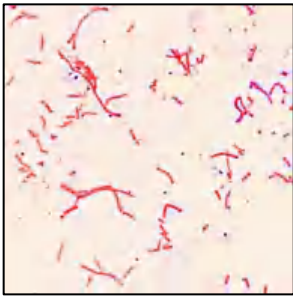
LPE-4a



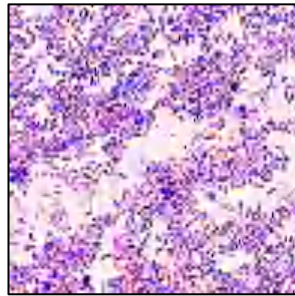
LPE-5a



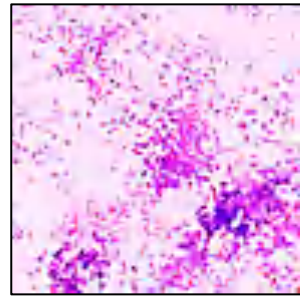
Lampiran 8. Hasil Pengecatan Gram



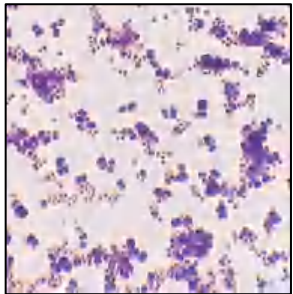
SPB-1a



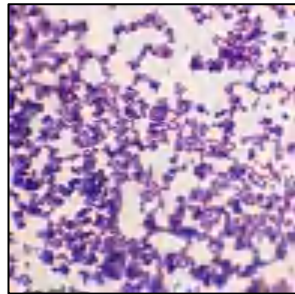
SPB-2a



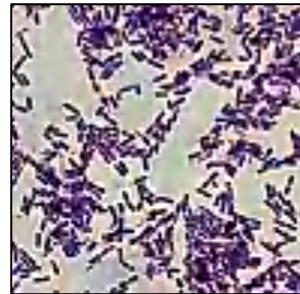
SPB-2b



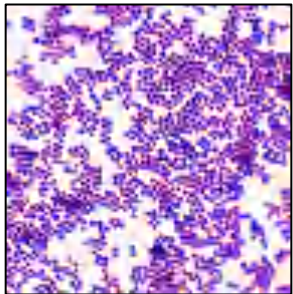
SPB-5a



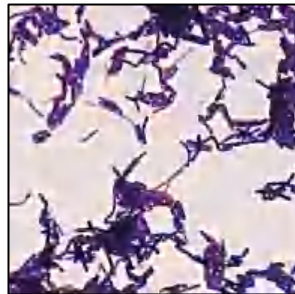
SPB-5b



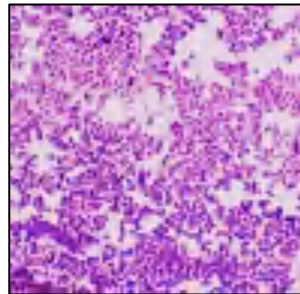
SPB-7a



LTP-2a



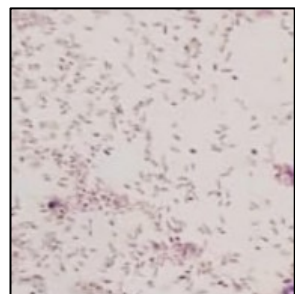
LTP-3a



LTP-6a



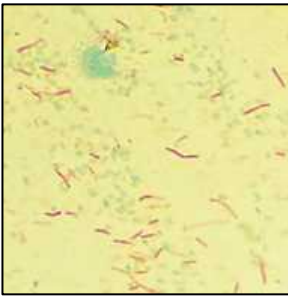
LPE-4a



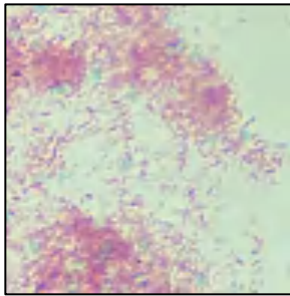
LPE-5a



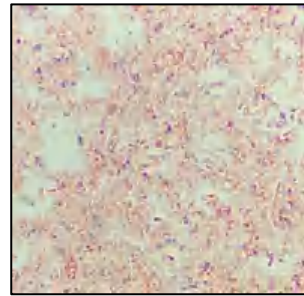
Optimization Software:
www.balesio.com

Lampiran 9. Hasil Pengecatan Endospora

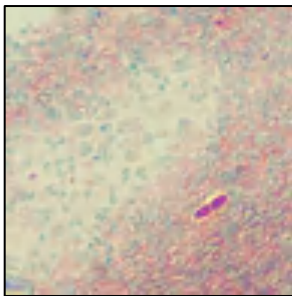
SPB-2a



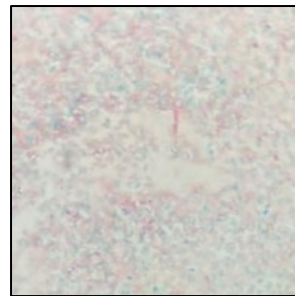
SPB-2b



LTP-3a



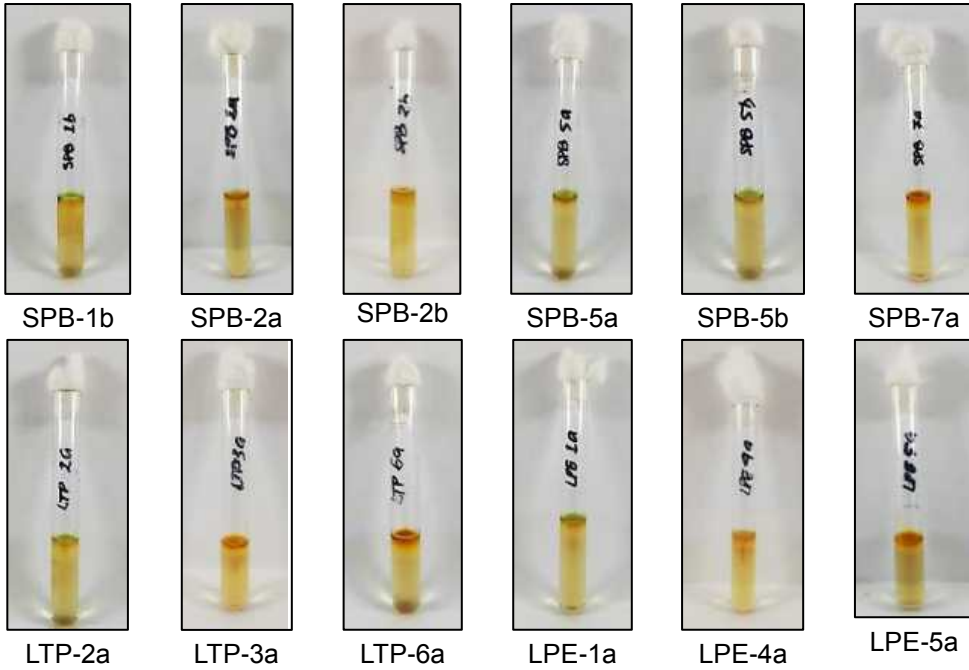
SPB-7a



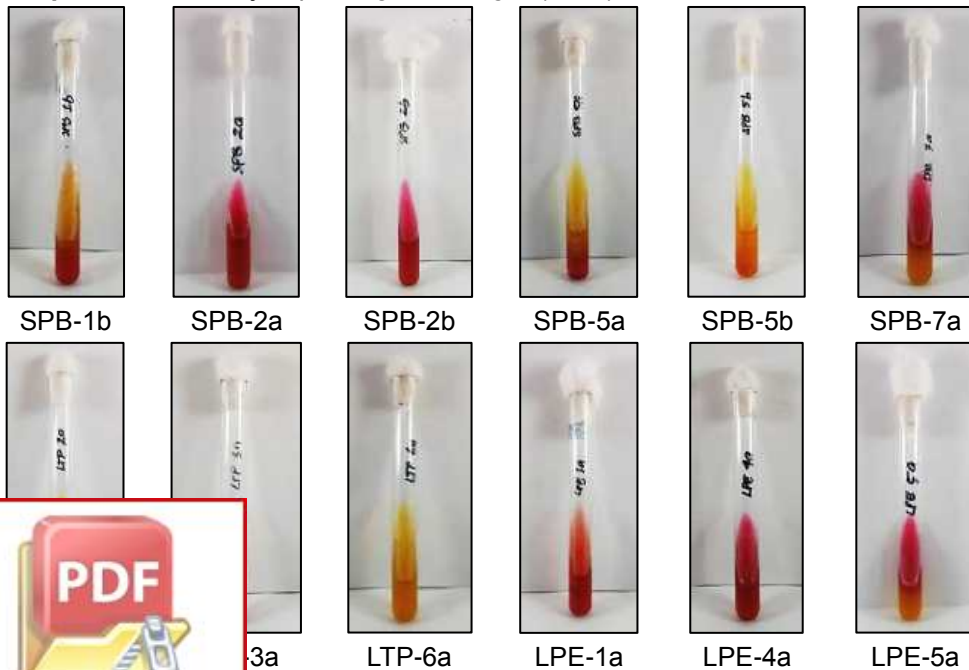
LPE-5a



Lampiran 10. Hasil Uji *Sulfide Indole Motility* (SIM)



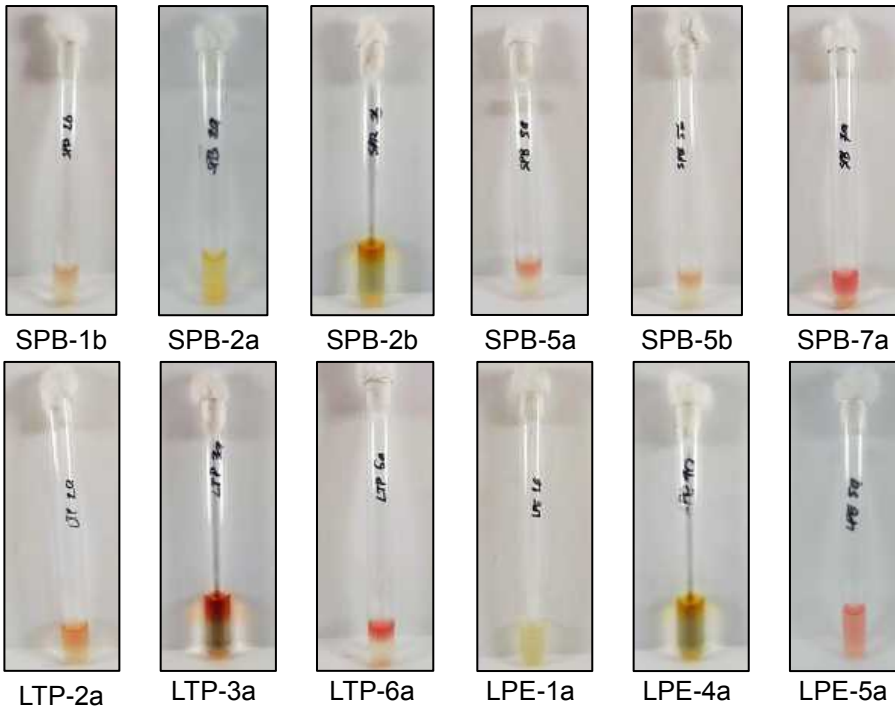
Lampiran 11. Hasil Uji *Triple Sugar Iron Agar* (TSIA)



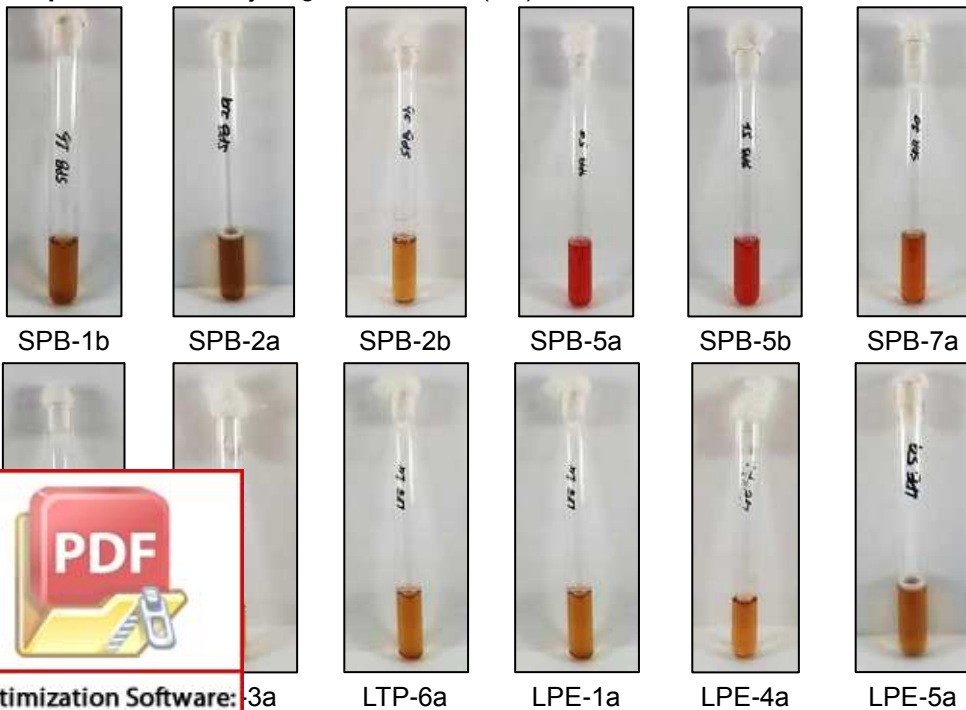
PDF

Optimization Software:
www.balesio.com

Lampiran 12. Hasil Uji Methyl Red (MR)

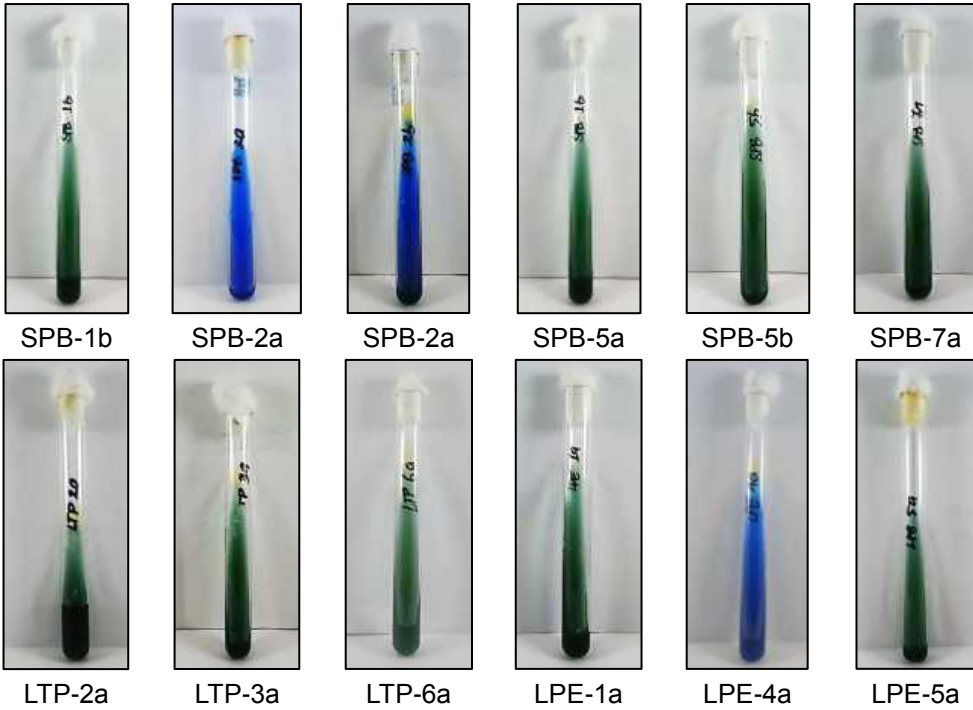


Lampiran 13. Hasil Uji Voges Proskauer (VP)

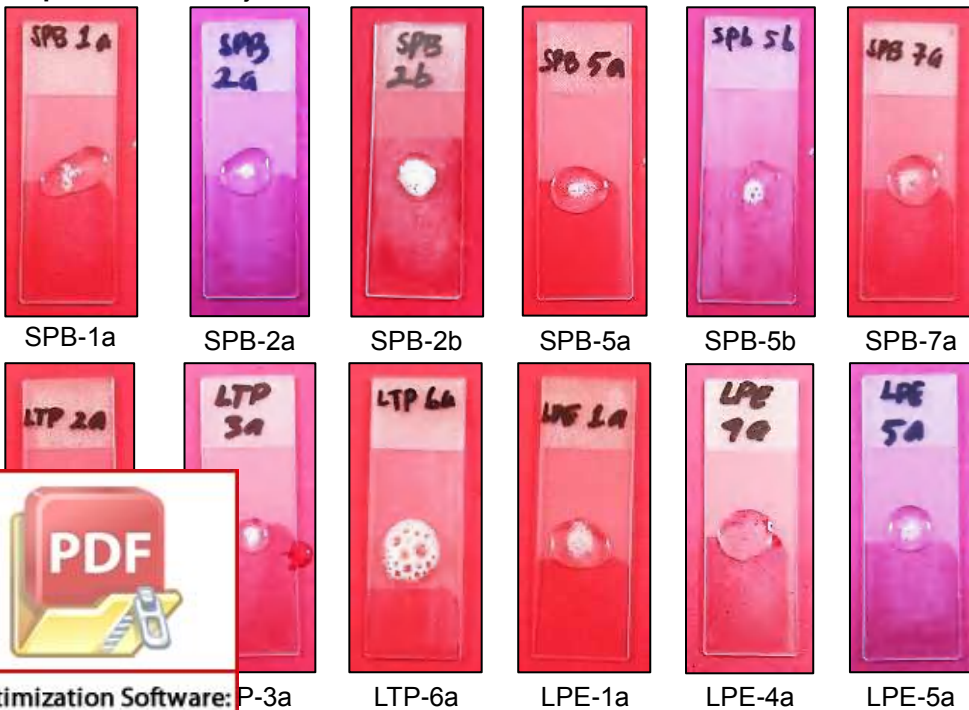


PDF
Optimization Software: www.balesio.com

Lampiran 14. Hasil Uji Sitrat

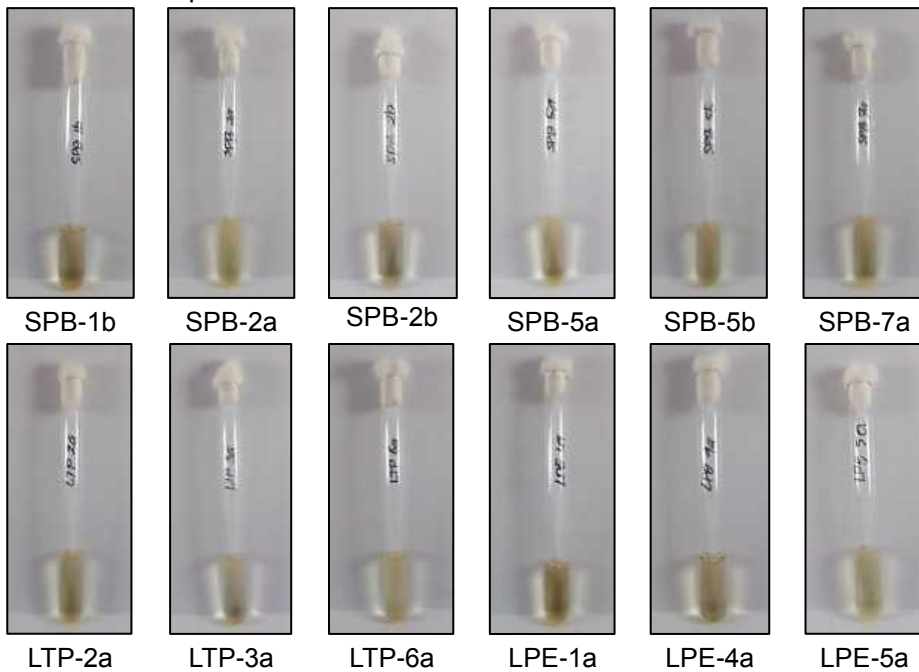


Lampiran 15. Hasil Uji Katalase

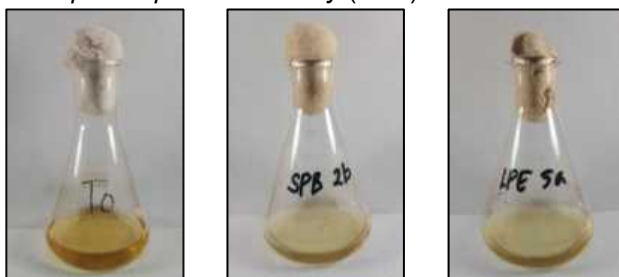


PDF
Optimization Software: www.balesio.com

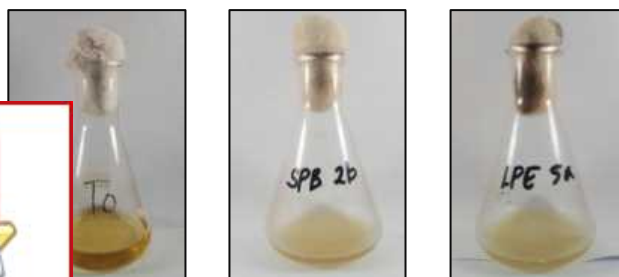
Lampiran 16. Uji Reduksi Besi oleh Bakteri Pereduksi Besi Menggunakan Spektrofotometer UV-Vis



Lampiran 17. Uji Reduksi Besi oleh Bakteri Pereduksi Besi Menggunakan Atomic Absorption Spectrofotometry (AAS)



Kultur T0



Kultur T3



Optimization Software:
www.balesio.com

Lampiran 18. Hasil Karakterisasi Bakteri Pereduksi Besi

Isolat	Morfologi				SIM			TSIA		MR-VP		Sitrat	Katalase
	Koloni	Bentuk	Gram	Endo spora	Motilitas	H ₂ S	Indol	Gula	Gas	MR	VP		
SPB-1b	<i>Circular</i>	<i>Bacilli</i>	Negatif	Negatif	+	-	-	A/K	-	+	-	-	+
SPB-2a	<i>Circular</i>	<i>Bacilli</i>	Positif	Positif	+	-	-	K/K	-	-	-	+	+
SPB-2b	<i>Circular</i>	<i>Bacilli</i>	Positif	Positif	+	-	-	K/K	-	-	-	+	+
SPB-5a	<i>Circular</i>	<i>Coccus</i>	Positif	Negatif	-	-	-	A/A	-	+	+	-	+
SPB-5b	<i>Circular</i>	<i>Coccus</i>	Positif	Negatif	+	-	-	A/A	-	+	+	-	+
SPB-7a	<i>Circular</i>	<i>Bacilli</i>	Positif	Positif	+	-	-	K/A	-	+	+	-	+
LTP-2a	<i>Circular</i>	<i>Coccus</i>	Positif	Negatif	+	-	-	A/K	-	+	+	-	+
LTP-3a	<i>Circular</i>	<i>Bacilli</i>	Positif	Positif	-	-	-	A/K	-	+	-	-	+
LTP-6a	<i>Circular</i>	<i>Coccus</i>	Positif	Negatif	+	-	-	A/A	-	+	-	-	+
LPE-1a	<i>Circular</i>	<i>Coccus</i>	Positif	Negatif	-	-	-	K/K	-	-	-	-	+
LPE-4a	<i>Circular</i>	<i>Bacilli</i>	Positif	Positif	-	-	-	K/K	-	-	-	+	-
LPE-5a	<i>Circular</i>	<i>Bacilli</i>	Positif	Negatif	-	-	-	K/A	-	+	-	-	+



Lampiran 19. Hasil Perhitungan Analisa Reduksi Besi menggunakan Spektrofotometer UV-Vis

Isolat	Pengenceran			Absorbansi	Kadar sisa Fe	
	Sampel	H ₂ O	FP		ppm	mmol
SPB-1b	1	49	50	0.003	3.0682	0.0110
SPB-2a	1	49	50	0.002	2.9545	0.0106
SPB-2b	1	49	50	0.001	2.8409	0.0102
SPB-5a	1	49	50	0.005	3.2955	0.0119
SPB-5b	1	49	50	0.003	3.0682	0.0110
SPB-7a	1	49	50	0.09	12.9545	0.0466
LTP-2a	1	49	50	0.019	4.8864	0.0176
LTP-3a	1	49	50	0.003	3.0682	0.0110
LTP-6a	1	49	50	0.006	3.4091	0.0123
LPE-1a	1	49	50	0.008	3.6364	0.0131
LPE-4a	1	49	50	0.002	2.9545	0.0106
LPE-5a	1	49	50	0.001	2.8409	0.0102

*FP: Faktor Pengenceran



Lampiran 20. Hasil Perhitungan Analisa Reduksi Besi menggunakan *Atomic Absorption Spectrofotometry* (AAS)

Besi (ppm)	Sampel		Konsentrasi besi terukur (ppm)	Kadar besi sisa (ppm)	Persentase reduksi (%)
	Sampel Awal (mL)	Pengenceran (mL)			
	10	50	3.4372	16.843	66.314%
	10	50	3.1235	15.2745	69.451%



Optimization Software:
www.balesio.com

Lampiran 21. Surat Keterangan Hasil Uji menggunakan *Atomic Absorption Spectrofotometry (AAS)*

		Kementerian Kesehatan Labkesmas Makassar I Jl. Perintis Kemerdekaan KM. 11 Kec. Tamalanrea Makassar 90245 0811415655 www.bbblabkesmasmakassar.go.id				
LAPORAN HASIL UJI <i>Report of Analysis</i> No : 24007089 - 24007091 / LHU / BBLK-MKS / III / 2024						
Nama Customer	: SARWAN					
Customer Name	:					
Alamat	: Jalan Sukaria 8 Kel. Tamamaung Kec. Panakkukang					
Address	:					
Jenis Sampel	: Nutrient Broth					
Type of Sample (S)	:					
No. Sampel	: 24007089 - 24007091					
No. Sample	:					
Tanggal Penerimaan	: 26 Maret 2024					
Received Date	: March 26, 2024					
Tanggal Pengujian	: 26 Maret 2024	s/d 01 April 2024				
Test Date	: March 26, 2024	to April 01, 2024				
HASIL PEMERIKSAAN						
No	No. Lab	Kode Sampel	Parameter	Satuan	Hasil Uji	Spesifikasi Metode
1	24007090	LPE 5a	Besi (Fe)	mg/L	16,843	SMAPHA 23rd Ed. 3111 B, 2017
Catatan : 1 Hasil uji ini berlaku untuk sampel yang diuji Note : The analytical result are only valid for the tested sample 2 Laporan hasil uji ini terdiri dari 1 halaman The report of analysis consists of 1 page 3 Laporan hasil uji ini tidak boleh digandakan kecuali secara lengkap dan secara tertulis Laboratorium Penguji Labkesmas Makassar ! This report of analysis shall not be reproduced (copied) except for the completed one and with their written permission of the testing Laboratory Labkesmas Makassar !						
						



LAPORAN HASIL UJI
Report of Analysis

No : 24007089 - 24007091 / LHU / BBLK-MKS / III / 2024

Nama Customer : SARWAN
 Customer Name :
 Alamat : Jalan Sukaria 8 Kel. Tamamaung Kec. Panakkukang
 Address :
 Jenis Sampel : Nutrient Broth
 Type of Sample (S) :
 No. Sampel : 24007089 - 24007091
 No. Sample :
 Tanggal Penerimaan : 26 Maret 2024
 Received Date : March 26, 2024
 Tanggal Pengujian : 26 Maret 2024
 Test Date : March 26, 2024

HASIL PEMERIKSAAN

No	No. Lab	Kode Sampel	Parameter	Satuan	Hasil Uji	Spesifikasi Metode
1	24007091	SPB 2b	Besi (Fe)	mg/L	15,275	SM APHA 23rd Ed. 3111 B, 2017

Catatan : 1 Hasil uji ini berlaku untuk sampel yang diuji
 Note : The analytical result are only valid for the tested sample

2 Laporan hasil uji ini terdiri dari 1 halaman
 The report of analysis consists of 1 page

3 Laporan hasil uji ini tidak boleh digandakan kecuali secara lengkap dan sesuai terdapat Laboratorium Pengujian Labkesmas Makassar I
 This report of analysis shall not be reproduced (copied) except for the completed one and with their written permission of the testing Laboratory Labkesmas Makassar I



Lampiran 22. Dokumentasi Prosedur Penelitian

Tahapan Isolasi Bakteri Pereduksi Besi



Tahapan Karakterisasi Bakteri Pereduksi Besi



Pengukuran Kadar Besi Menggunakan Spektrofotometer UV-Vis

Pengukuran Kadar Besi Menggunakan *Atomic Absorption Spectrofotometry*