

DAFTAR PUSTAKA

- Akbar, N. et al. (2018) 'Kajian Filogenetik Ikan Tuna (*Thunnus spp*) sebagai Data Pengelolaan di Perairan Sekitar Kepulauan Maluku, Indonesia', *Jurnal Kelautan: Indonesian Journal of Marine Science and Technology*, 11(2), p. 120. doi: 10.21107/jk.v11i2.3459.
- Anggereini, E. (2008) 'Random Amplified Polymorphic DNA (RAPD), Suatu Metode Analisis DNA dalam Menjelaskan Berbagai Fenomena Biologi.', *Biopecies*, 1(2), pp. 73–76. doi: 10.21082/blpn.v14n2.2008.p57-67.
- Azizah, A. (2009) *Perbandingan Pola Pita Amplifikasi DNA Daun, Bunga, dan Buah Kelapa Sawit Normal dan Abnormal*. Institut Pertanian Bogor.
- Brown, C. (1998) *Fish Diseases and Disorders*, Volume 2, CABI. doi: 10.1079/9781845935535.0000.
- Dedi, J. et al. (1997) 'Hypervitaminosis A during Vertebral Morphogenesis in Larval Japanese Flounder', *Fisheries Science*, 63(3), pp. 466–473.
- Faatih, M. (2009) 'Isolasi dan Digesti DNA Kromosom', *J Penelitian Sains dan Teknologi*, 10(1), pp. 61–67.
- Fatchiyah, Widyarti, S. and Arumingtyas, E. L. (2018) *Teknik Analisa Biologi Molekuler*. Malang: Universitas Brawijaya.
- Finkeldey (2005) *Pengantar Genetika Ikan*. Bogor: Institut Pertanian Bogor.
- Fitriya, R. T., Ibrahim, M. and Lisdiana, L. (2015) 'Keefektifan Metode Isolasi DNA Kit dan CTAB/NaCl yang dimodifikasi pada *Staphylococcus aureus* dan *Shigella dysentriiae*', *LenteraBio*, 4(1), pp. 87–92.
- Fraser, M. R. and Nys, R. D. (2011) 'A Quantitative Determination of Deformities in Barramundi (*Lates calcarifer*, Bloch) Fed a Vitamin Deficient Diet', *Aquaculture Nutrition*, 17, pp. 235–243. doi: 10.1111/j.1365-2095.2009.00734.x.
- Gil Martens, L. et al. (2006) 'Impact of High Water Carbon Dioxide Levels on Atlantic Salmon Smolts (*Salmo salar* L.): Effects on Fish Performance, Vertebrae Composition and Structure', *Aquaculture*, 261(1), pp. 80–88. doi: 10.1016/j.aquaculture.2006.06.031.
- Gillespie, R. B. and Baumann, P. C. (1986) 'Effects of High Tissue Concentrations of Selenium on Reproduction by Bluegills', *Transactions of the American Fisheries Society*, 115(2), pp. 208–213. doi: 10.1577/1548-8659(1986)115<208:eohtco>2.0.co;2.
- Guo, Z. H. et al. (2014) 'Molecular Insights into the Genetic Diversity of *Hemarthria compressa* Germplasm Collections Native to Southwest China', *Molecules*, 19(12), pp. 21541–21559. doi: 10.3390/molecules191221541.
- Gusmiaty, G. et al. (2016) 'Polimorfisme Penanda RAPD untuk Analisis Keragaman Genetik *Pinusmerkusii* di Hutan Pendidikan Unhas', *Jurnal Natur Indonesia*, 16(2), pp. 47–53. doi: 10.31258/jnat.16.2.47-53.

- Gustiano, R. et al. (2013) 'Analisis Ragam Genotip RAPD Dan Fenotip Truss Morfometrik Pada Tiga Populasi Ikan Gabus [*Channa striata* (Bloch, 1793)]', *Berita Biologi*, 12(3), pp. 325–333.
- Hariyadi, S. et al. (2018) 'Perbandingan Metode Lisis Jaringan Hewan dalam Proses Isolasi DNA Genom pada Organ Liver Tikus Putih (*Rattus norvegicus*) The Comparison Lysis Methods of Animal Tissue in Genomic DNA Isolation Process in Liver Organ of White Rat (*Rattus Norvegicus*)', in *Biology Education Conference*, pp. 689–692.
- Hayuningtyas, E. P. and Kadarini, T. (2016) 'Keragaman Genotipe Tiga Generasi Ikan Rainbow Kurumoi (*Melanotaenia parva*) Hasil Domestikasi Berdasarkan RAPD', *Riset Akuakultur*, 11(2), pp. 107–114.
- Hermanutz, R. O. et al. (1992) 'Effect of Elevated Selenium Concentrations on Bluegills (*Lepomis macrochirus*) in Outdoor Experimental Streams', *Environmental Toxicology and Chemistry*, 11, pp. 217–224.
- Hermanutz, R. O. (1992) 'Malformation of the Fathead Minnow (*Pimephales promelas*) in an Ecosystem with Elevated Selenium Concentrations', *Bull. Environ. Contam. Toxicol.*, 49, pp. 290–294.
- Hidayat, T. opik and Pancoro, A. (2008) 'Kajian Filogenetika Molekuler dan Peranannya dalam Menyediakan Informasi Dasar untuk Meningkatkan Kualitas Sumber Genetik Anggrek Topik', *AgroBiogen*, 4(1), pp. 35–40.
- Irmawati (2003) *Perubahan Keragaman Genetik Ikan Kerapu Tikus (*Cromileptes altivelis*) Generasi Pertama pada Stock Hatchery*. Institut Pertanian Bogor.
- Irmawati, I. et al. (2020) 'Distribution and Characteristics of Asian seabass (*Lates calcarifer* Bloch, 1790) in South Sulawesi Distribution and characteristics of Asian Seabass (*Lates calcarifer* Bloch, 1790) in South Sulawesi', in *The 3rd International Symposium Marine and Fisheries (ISMF) 2020: Earth and Environmental Science*. Makassar, pp. 1–8. doi: 10.1088/1755-1315/564/1/012011.
- Irmawati, I., Alimuddin, A. and Tasakka, A. C. M. A. . (2019) *Budidaya Ikan Kakap Putih (*Lates calcarifer* Bloch, 1790) Berbasis Ekosistem*. Makassar: Lembaga Penelitian dan Pengabdian pada Masyarakat. doi: 10.13140/RG.2.2.36149.22243.
- Ismi, S. (2020) 'Beberapa Macam Cacat Tubuh yang Terjadi pada Benih Ikan Kerapu Cantang Hasil Hatchery', *Journal of Fisheries and Marine Research*, 4(1), pp. 94–101.
- Iswanto, B. and Suprapto, R. (2015) 'Abnormalitas Morfologis Benih Ikan Lele Afrika (*Clarias gariepinus*) Strain Mutiara', *Media Akuakultur*, 10(2), pp. 51–57. doi: 10.15578/ma.10.2.2015.51-57.
- Khang, P. Van et al. (2018) 'An 8-Year Breeding Program for Asian Seabass *Lates calcarifer*: Genetic Evaluation, Experiences, and Challenges', *Frontiers in Genetics*, 9, pp. 1–12. doi: 10.3389/fgene.2018.00191.
- Kimberley (2011) *Barramundi, Fish for the future*. Available at: www.thebetterfish.com/oceans%0A (Accessed: 8 August 2020).

- Kitajima, C. et al. (1994) 'Lordotic Deformation and Abnormal Development of Swim Bladders in Some Hatchery-Bred Marine Physoclistous Fish in Japan', *Journal of the World Aquaculture Society*, 25(1), pp. 64–77. doi: 10.1111/j.1749-7345.1994.tb00806.x.
- Koh, T. L. et al. (1999) 'Genetic Diversity Among Wild Forms and Cultivated Varieties of Discus (*Syphodus* spp.) as Revealed by Random Amplified Polymorphic DNA (RAPD) Fingerprinting', *Aquaculture*, 173, pp. 485–497. doi: 10.1016/S0044-8486(98)00478-5.
- Kruuk, L. E. B. (2004) 'Estimating Genetic Parameters in Natural Populations using the "Animal Model"', *The Royal Society*, pp. 873–890. doi: 10.1098/rstb.2003.1437.
- Kurnia, N. (2010) *Autentifikasi Ikan Tuna (Thunnus sp) Dengan Metode Berbasis PCR-Sequencing*. Institut Pertanian Bogor.
- Kusmini, I. I. et al. (2016) 'Karakterisasi Fenotipe dan Genotipe Tiga Populasi Ikan Tengadak (*Barbomyrus schwanenfeldii*)', *Jurnal Riset Akuakultur*, 11(3), pp. 207–216. doi: 10.15578/jra.11.3.2016.207-216.
- Lante, S. et al. (2011) 'Keragaman Genetik Populasi Ikan Beronang (*Siganus guttatus*) di Selat Makassar dan Teluk Bone Menggunakan Metode Random Amplified Polymorphic DNA (RAPD)', *Jurnal Riset Akuakultur*, 6(2), pp. 211–224. doi: 10.15578/jra.6.2.2011.211-224.
- Lemly, A. D. (1993) 'Teratogenic Effects of Selenium in Natural Populations of Fresh Water Fish', *Ecotoxicology and Environmental Safety*, 26(2), pp. 181–204. doi: 10.1006/eesa.1993.1049.
- Luo, C. and Li, B. (2003) 'Diploid-Dependent Regulation of Gene Expression: A Genetic cause of Abnormal Development in Fish Haploid Embryos', *Heredity*, 90(5), pp. 405–409. doi: 10.1038/sj.hdy.6800263.
- Mafiana, B. D. (2015) *Isolasi DNA*, Academia.Edu. Available at: http://www.academia.edu/19608268/TUGAS_MATA_KULIAH_BIOLOGI_JURNAL_ISOLASI_DNA (Accessed: 15 February 2020).
- MAI (2018) *Kakap Putih yang Mendunia*. Available at: <https://aquaculture-mai.org/archives/2419>.
- Mathew, G. (2009) 'Taxonomy, Identification and Biology of Seabass (*Lates calcarifer*)', Central Marine Fisheries Research Institute. Kerala: Central Marine Fisheries Research Institute, pp. 38–43.
- Mulliadi, D. and Arifin, J. (2010) 'Pendugaan Keseimbangan Populasi dan Heterozigositas Menggunakan Pola Protein Albumin Darah pada Populasi Domba Ekor Tipis (Javanese Thin Tailed) di Daerah Indramayu', *Jurnal Ilmu Ternak*, 10(2), pp. 65–72.
- Mulyasari (2010) *Karakteristik Fenotipe Morfomeristik dan Keragaman Genotipe RAPD (Randomly Amplified Polymorphism DNA) Ikan Nilem (*Osteochilus hasselti*) di Jawa Barat*. Institut Pertanian Bogor. Available at: <https://repository.ipb.ac.id/jspui/bitstream/123456789/41158/9/2010mul.pdf>.

- Nei, M. (1987) *The Measurement of Genetic Variation*. Available at: <http://erath.agu.org/revgeographys/buckli01/node14.html>. (Accessed: 12 August 2020).
- Nugroho, E., Soewardi, K. and Kurniawirawan, A. (2007) 'Analisis Keragaman Genetik Beberapa Populasi Ikan Batak (Tor solo) dengan Metode Random Amplified Polymorphism DNA (RAPD)', *Jurnal Ilmu-Ilmu Perairan dan Perikanan Indonesia*, 14(2), pp. 133–137.
- Nurhaemi-Haris *et al.* (2003) 'Kemiripan Genetik Kon karet (*Hevea brasiliensis* Muell Arg.) Berdasarkan Metode Amplified Fragment Length Polymorphisms (AFLP)', *Menara Perkebunan*, 71(1), pp. 1–15.
- Olivia, R. D. (2012) *Keragaman Genetik Populasi Sengon (Paraserianthes falcataria (L) Nielsen) pada Hutan Rakyat di Jawa Berdasarkan Penanda RAPD*, Institut Pertanian Bogor. Institut Pertanian Bogor.
- Pharmawati, M. (2009) 'Optimalisasi Ekstraksi DNA dan PCR-RAPD pada *Grevillea* Spp. (Proteaceae)', *Jurnal Biologi Udayana*, 13(1), pp. 12–16.
- Prakoso, V. A. and Kurniawan (2015) 'Pengaruh Stressor Suhu dan Salinitas Terhadap Perkembangan Embrio Ikan Nilem (*Osteochilus hasselti*)', *Sains Natural*, 5(1), pp. 49–59.
- Probojati, R. T., Wahyudi, D. and Hapsari, L. (2019) 'Clustering Analysis and Genome Inference of Pisang Raja Local Cultivars (*Musa* spp.) from Java Island by Random Amplified Polymorphic DNA (RAPD) Marker', *Tropical Biodiversity and Biotechnology*, 4(2), pp. 42–54.
- Pyron, M. and Beitinger, T. L. (1989) 'Effect of Selenium on Reproductive Behavior and Fry of Fathead Minnows', *Bulletin of Environmental Contamination and Toxicology*, 42(4), pp. 609–613. doi: 10.1007/BF01700245.
- Rayes, R. D. (2013) 'Pengaruh Perubahan Salinitas Terhadap Pertumbuhan dan Sintasan Ikan Kakap Putih (*Lates calcarifer* Bloch)', *Jurnal KELAUTAN*, 16(1), pp. 47–56.
- Razi, F. (2013) *Penanganan Hama dan Penyakit pada Ikan Kakap Putih*. Jakarta: Kementerian Kelautan dan Perikanan.
- Ritonga, S. W. *et al.* (2014) *DNA Barcodes For Marine Biodiversity Determinasi dan Identifikasi Alga Merah (Rhodophyta) di Pantai Cipatujah, Tasikmalaya Melalui Identifikasi Molekuler DNA Barcoding*. Institut Pertanian Bogor.
- Santos, R. *et al.* (2013) 'Relationship Between DNA Damage in Sperm after ex vivo Exposure and Abnormal Embryo Development in the Progeny of the Three-pined Stickleback', *Reproductive Toxicology*. Elsevier Inc., 36, pp. 6–11. doi: 10.1016/j.reprotox.2012.11.004.
- Schultz, R. and Hermanutz, R. (1990) 'Transfer of Toxic Concentrations of Selenium from Parent to Progeny in the Fathead Minnow (*Pimephales promelas*)', *Bulletin of Environmental Contamination and Toxicology*, 45(4), pp. 568–573. doi: 10.1007/BF01700630.
- Shafira, N. (2018) *Abnormalitas Ikan Mas Cyprinus carpio pada Air Hasil Treatment*

Fitoremediasi Akibat Cemaran Limbah Minyak Jelantah. Institut Pertanian Bogor.

Shao, Y. T. et al. (2018) 'Largescale Mullet (*Planiliza macrolepis*) Can Recover from Thermal Pollution-Induced Malformations', *PLoS ONE*, 13(11), pp. 1–14. doi: 10.1371/journal.pone.0208005.

Takeuchi, T. et al. (1995) 'The Effect of β -Carotene and Vitamin A Enriched Artemia Naupli on the Malformation and Color Abnormality of Larval Japanese Flounder', *Fisheries Science*, 61(1), pp. 141–148.

Wakida-Kusunoki, A., Amador-Delangel, L. and Moreno-Miranda, C. (2014) 'Spinal Deformities in Amazon Sailfin Catfish *Pterygoplichthys pardalis* (Siluriformes: Locariidae), an Introduced Fish in the Palizada River (Southeastern Mexico)', *Cybium*, 38(2), pp. 155–157.

Wallace, C. (2013) 'Statistical Testing of Shared Genetic Control for Potentially Related Traits', *Genetic Epidemiology*, 37(8), pp. 802–813. doi: 10.1002/gepi.21765.

Wigati, E., Sutarno and Haryanti (2003) 'Variasi Genetik Ikan Anggoli (*Pristipomoide multidens*) Berdasarkan Pola Pita Allozym', *Biodiversitas, Journal of Biological Diversity*, 4(2), pp. 73–79. doi: 10.13057/biodiv/d040201.

Woock, S. E. et al. (1987) 'Decreased Survival and Teratogenesis during Laboratory Selenium Exposures to Bluegill, *Lepomis macrochirus*', *Bulletin of Environmental Contamination and Toxicology*, 39(6), pp. 998–1005. doi: 10.1007/BF01689590.

LAMPIRAN

Lampiran 1. Perhitungan presentase abnormalitas ikan kakap putih (*Lates calcarifer* Bloch, 1790) hasil domestikasi yang dibesarkan di Keramba Jaring Apung (KJA) Desa Lawallu, Kecamatan Soppeng Riaja, Kabupaten Barru

1) Abnormalitas sirip dorsal

$$\text{Abnormalitas (\%)} = \frac{\text{Jumlah ikan abnormal}}{\text{Jumlah ikan yang diamati}} \times 100 = \frac{5}{20} \times 100 = 25\%$$

2) Abnormalitas sirip perut

$$\text{Abnormalitas (\%)} = \frac{\text{Jumlah ikan abnormal}}{\text{Jumlah ikan yang diamati}} \times 100 = \frac{5}{20} \times 100 = 25\%$$

3) Abnormalitas sirip Anal

$$\text{Abnormalitas (\%)} = \frac{\text{Jumlah ikan abnormal}}{\text{Jumlah ikan yang diamati}} \times 100 = \frac{3}{20} \times 100 = 15\%$$

4) Abnormalitas Operkulum

$$\text{Abnormalitas (\%)} = \frac{\text{Jumlah ikan abnormal}}{\text{Jumlah ikan yang diamati}} \times 100 = \frac{4}{20} \times 100 = 20\%$$

5) Presentase Abnormalitas Sampel Hasil Domestikasi

$$\text{Abnormalitas (\%)} = \frac{\text{Jumlah ikan abnormal}}{\text{Jumlah ikan yang diamati}} \times 100 = \frac{13}{20} \times 100 = 65\%$$

Lampiran 2. Alat dalam analisis molekuler dengan penanda *Random Amplified Polymorphic DNA* (RAPD)



Timbangan digital



Inkubator



Vortex



Mesin PCR



Gel doc

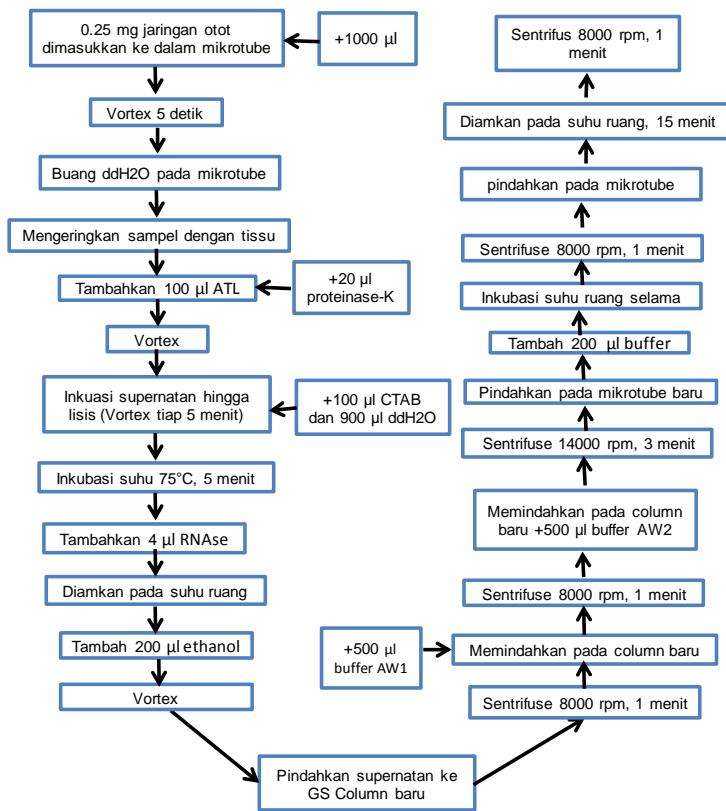


Mikropipet dan tip

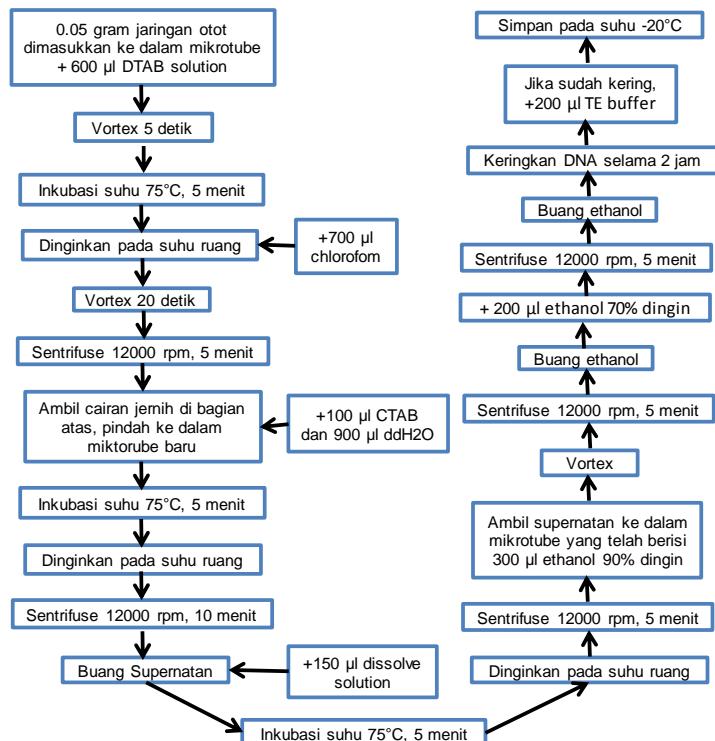


Elektroforesis

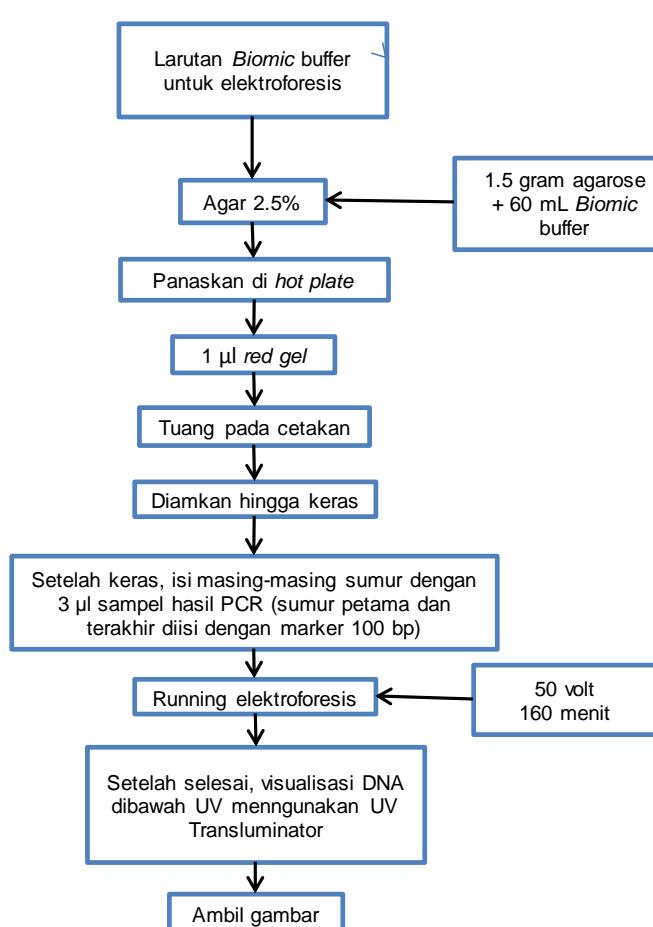
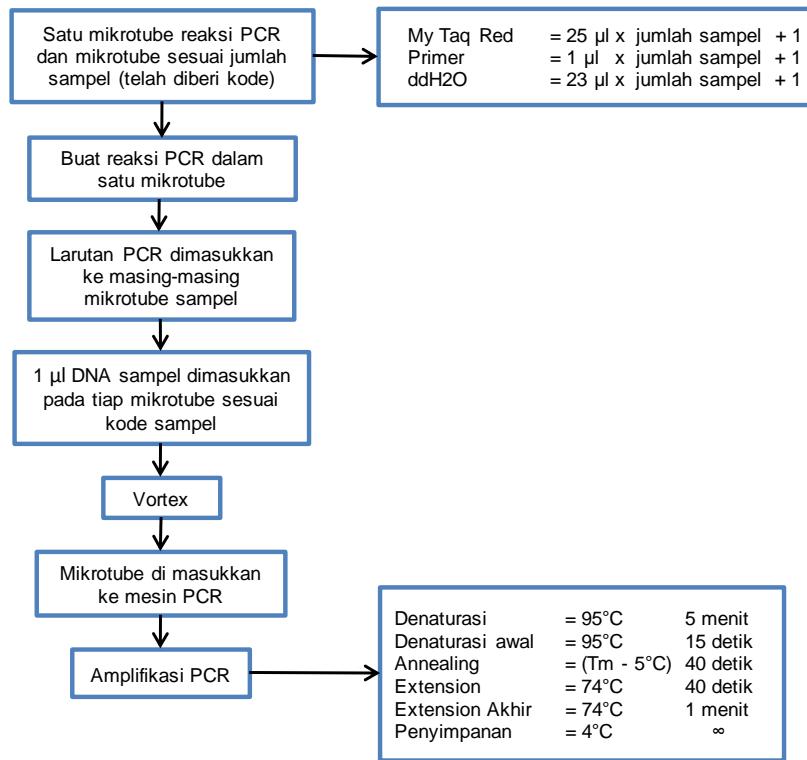
Lampiran 4. Bagan tahapan analisis molekuler menggunakan metode PCR-RAPD pada sampel ikan kakap putih (*Lates calcarifer* Bloch, 1790)



Bagan tahapan isolasi DNA dengan menggunakan Kit *DNAeasy blood tissue* (Qiagen, German)



Bagan tahapan isolasi DNA dengan menggunakan metode CTAB-DTAB



Bagan tahapan elektroforesis dengan menggunakan agar 2,5%

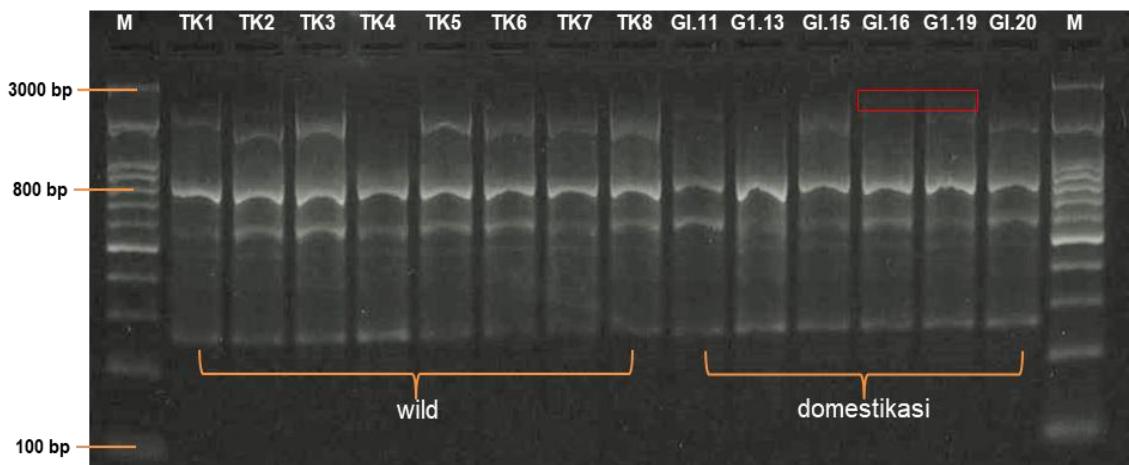
Lampiran 4. Data skoring hasil amplifikasi sampel ikan kakap putih (*Lates calcarifer* Bloch, 1790) dengan menggunakan tiga primer.

OPC-08	TK1	TK2	TK3	TK4	TK5	TK6	TK7	TK8	GI.11	GI.13	GI.15	GI.16	GI.19	GI.20
2250	0	0	0	0	0	0	0	0	0	0	0	1	1	0
1900	1	0	0	0	0	0	0	0	1	0	0	1	1	0
1500	0	1	1	0	1	1	1	1	0	0	1	0	0	1
750	1	1	1	1	1	1	1	1	1	1	1	1	1	1
585	1	1	1	1	1	1	1	1	1	1	1	1	1	1
485	1	1	1	1	1	1	1	1	1	1	1	1	1	1
375	1	1	1	1	1	1	1	1	1	1	1	1	1	1
275	1	1	1	1	1	1	1	1	1	1	1	1	1	1

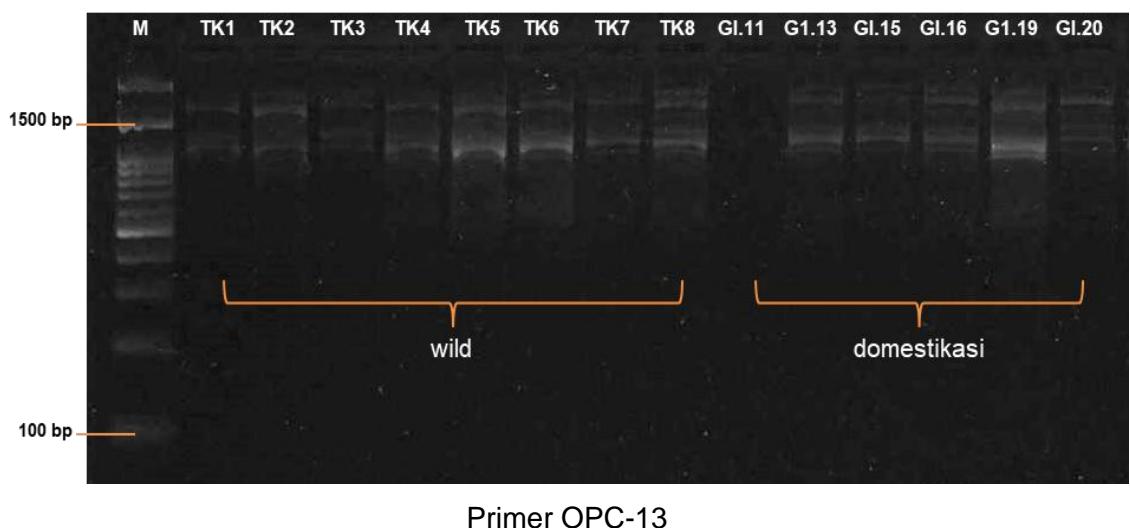
OPC-13	TK1	TK2	TK3	TK4	TK5	TK6	TK7	TK8	GI.11	GI.13	GI.15	GI.16	GI.19	GI.20
2910	1	1	1	1	1	1	1	1	0	1	1	1	1	1
2300	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2063	1	1	0	0	1	0	0	0	0	0	0	0	1	1
1900	0	0	1	1	1	1	0	1	0	1	1	1	1	1
1375	1	1	1	1	1	1	1	1	1	1	1	1	0	1
1250	1	1	1	1	0	0	1	1	0	1	1	1	1	1
1125	0	0	0	0	1	1	1	1	0	1	1	1	1	1
1000	0	1	0	0	0	1	0	0	0	0	0	0	1	0

OPC-19	TK1	TK2	TK3	TK4	TK5	TK6	TK7	TK8	GI.11	GI.13	GI.15	GI.16	GI.19	GI.20
2625	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2250	1	1	1	1	1	1	1	1	0	1	1	1	1	1
1700	1	1	0	0	1	1	1	1	1	0	0	0	0	0
1375	1	1	1	1	1	1	1	1	0	1	1	1	1	1
1125	0	1	1	0	1	1	1	0	0	0	1	0	0	0
900	1	1	1	1	1	1	1	1	0	1	1	1	1	1
850	0	0	0	1	1	0	1	1	0	1	0	0	1	0
750	1	1	1	1	1	1	1	1	0	1	1	1	1	1
650	0	1	1	1	0	0	0	0	0	0	1	1	0	0
600	0	1	0	1	1	1	1	0	0	1	1	1	0	0

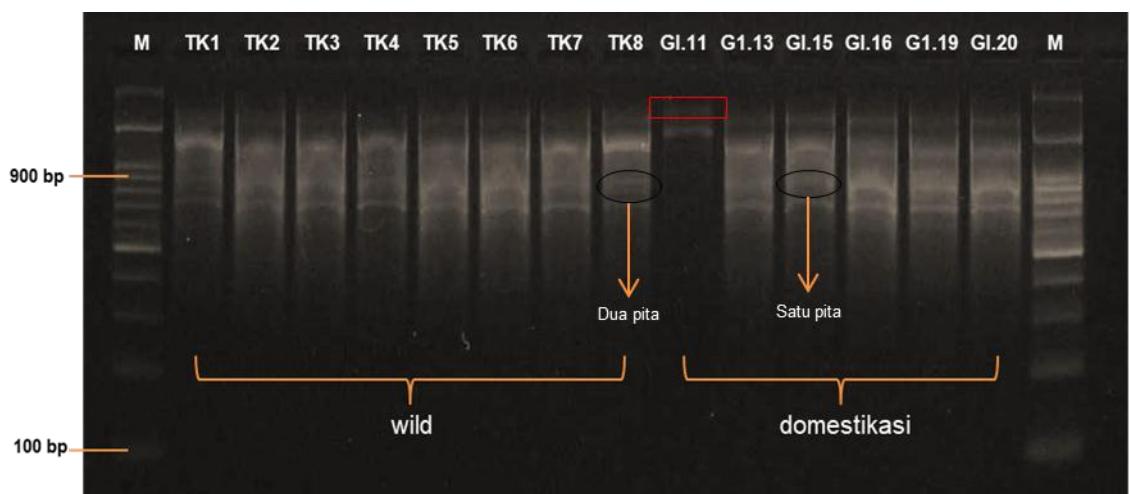
Lampiran 4. Hasil amplifikasi DNA ikan kakap putih (*Lates calcarifer* Bloch, 1790) dengan marker 100 bp. TK= sampel ikan kakap putih tipe liar dari Muara Sungai Saro' Kabupaten Takalar, GI= sampel ikan kakap putih domestikasi dari KJA Desa Lawallu Kabupaten Barru



Primer OPC-08



Primer OPC-13



Primer OPC-19