

## DAFTAR PUSTAKA

- Abdul Khalil, H. P. S., Saurabh, C. K., Tye, Y. Y., Lai, T. K., Easa, A. M., Rosamah, E., Fazita, M. R. N., Syakir, M. I., Adnan, A. S., Fizree, H. M., Aprilia, N. A. S., dan Banerjee, A. 2017. Seaweed based sustainable films and composites for food and pharmaceutical applications: A review. *Renewable and Sustainable Energy Reviews*. **77**: 353-362.
- Abidin, Z. 2015. Isolasi dan Karakterisasi Agarosa dari Rumpun Laut *Gracilaria verrucosa*. *Jurnal Ilmu Farmasi Indonesia*. **13**(1): 69-75.
- Adrin, G. R. 2017. *Isolasi Agarosa dari Agar dan Aplikasinya sebagai Adsorben Zat Warna pada Analisis Tartrazin dengan Metoda TLC Scanner*. Skripsi diterbitkan. Universitas Andalas. Padang.
- Agnihotri, S., Shukla, S., dan Pilla, S. 2020. Sustainability Issues in Bioplastics. *In Renewable and Sustainable Materials*. **5**: 249-273.
- Agustang, Mulyani, S., dan Indrawati, E. 2021. *Budidaya Rumpun laut Potensi Perairan Kabupaten Sinjai Sulawesi Selatan*. Gowa: Pusaka Almada.
- Aly, M. I. B., Ermin., Koroy, M. 2022. Pengaruh Lama Waktu Pengasapan Terhadap Kualitas Ikan Cakalang (*Katsuwonus Pelamis*) dan Ikan Tuna Tongkol (*Euthinus Affinis*) Berdasarkan Hasil Uji Organoleptik di Kota Ternate. *Jurnal Ilmiah Wahana Pendidikan*. **8**(21): 490-507.
- Alkhulaifi, M. M., Alshehri, J. H., Alwehaibi, M. A., Awad, M. A., Al-Enazi, N. M., Aldosari, N. S., Hatamleh, A. A., dan Abdel- Raouf, N. 2020. Green synthesis of silver nanoparticles using Citrus limon peels and evaluation of their antibacterial and cytotoxic properties. *Saudi Journal of Biological Sciences*. **27**(12): 3434-3441.
- Amanda, E. R., Nisyak, K., dan Prasetya, Y. A. 2020. Pengembangan Bioplastik Antibakteri *Morganella morganii* sebagai Kemasan Makanan. *Jurnal Kimia dan Kemasan*. **42**(1): 29-36.
- Amatya, S. P., dan Pradhan Joshi, L. 2020. Bio-Synthesis of copper nanoparticles (CuNPs) using Garlic extract to investigate antibacterial activity. *BIBECHANA*. **17**: 13-19.
- Amer, M. W., dan Awwad, A. M. 2021. Green synthesis of copper nanoparticles by Citrus limon fruits extract, characterization and antibacterial activity. *Chemistry Internasional*. **7**(1): 1-8.
- Amin, A., Mohd Sauid, S., Musa, M., dan Hamid, K. 2017. The effect of glycerol content on mechanical properties, surface morphology and water absorption of thermoplastic films from *tacca leontopetaloides* starch. *Jurnal Teknologi*. **79**(5-3): 53-59.
- Ansari, M. M., Shahid, M., dan Ansari, A. S. 2018. Synthesis and characterization of Cu nanoparticles by chemical reduction method. *AIP Conference Proceeding*. **1953**(1): 1-4.
- APHA. 2013. *Standard methods for the examination of water and wastewater*. American Public Health Association Inc. New York.
- Argudo, P., Guzmán, E., Lucia, A., Rubio, R., dan Ortega, F. 2018. Preparation and Application in Drug Storage and Delivery of Agarose Nanoparticles. *International Journal of Polymer Science*. **7823587**: 1-9.
- Arifuddin. 2007. *Penelusuran Protein Bioaktif dalam Makroalga sebagai Bahan Antibakteri Dan Antijamur*. Skripsi. Makassar: Universitas Hasanuddin.
- Aripin, S., Saing, B., dan Kustiyah, E. 2017. Studi Pembuatan Bahan Alternatif Plastik *Biodegradable* dari Pati Ubi Jalar dengan *Plasticizer* Gliserol dengan Metode *Melt*

- Intercalation. Jurnal Teknik Mesin Mercu Buana.* **6**(2): 79-84.
- Ariyanta, H. A. 2016. Preparasi Nanopartikel Perak dengan Metode Reduksi dan Aplikasinya sebagai Antibakteri Penyebab Luka Infeksi. *Media Kesehatan Masyarakat Indonesia.* **10**(1): 36-42.
- Aryani, A., dan Aprilia, H. 2022. Studi Literatur Sintesis Nanopartikel Tembaga Menggunakan Bioreduktor Ekstrak Tumbuhan dengan Aktivitas Antioksidan. *Jurnal Riset Farmasi.* **7**(2): 198-204.
- Aslinda, W., dan Ahmad, A. 2016. Isolasi dan Karakterisasi Agarosa dari Makroalga Merah *Euchema Cottoni* untuk Pemisahaan Fragmen DNA. *Natural Science: Journal of Science and Technology.* **5**(3): 307-313.
- Asmat-Campos, D., Delfin-Narciso, D., Juárez-Cortijo, L., dan Nazario-Naveda, R. 2021. Influence of the volume of ascorbic acid in the synthesis of copper nanoparticles mediated by chemical pathway and its stability over time. *IOP Conference Series: Earth and Environmental Science.* **897**(012010): 1-8.
- ASTM. 2013. *ASTM D6988-13: Standard guide for determination of thickness of plastic film test specimens.* American National Standards Institute. Philadelphia.
- Badawy, M. E. I., Lotfy, T. M. R., dan Shawir, S. M. S. 2019. Preparation and antibacterial activity of chitosan-silver nanoparticles for application in preservation of minced meat. *Bulletin of the National Research Centre.* **34**(6): 544-558,
- Bang, Y.-J., Roy, S., dan Rhim, J.-W. 2022. A Facile In Situ Synthesis of Resorcinol-Mediated Silver Nanoparticles and the Fabrication of Agar-Based Functional Nanocomposite Films. *Journal of Composites Science.* **6**(5): 1-14.
- Barboza, L. G. A., Dick Vethaak, A., Lavorante, B. R. B. O., Lundebye, A.-K., dan Guilhermino, L. 2018. Marine microplastic debris: An emerging issue for food security, food safety and human health. *Marine Pollution Bulletin.* **133**: 336-348.
- Borkow, G., Gabbay, J., Dardik, R., Eidelman, A. I., Lavie, Y., Grunfeld, Y., Ikher, S., Huszar, M., Zatcoff, R. C., dan Marikovsky, M. 2010. Molecular mechanisms of enhanced wound healing by copper oxide-impregnated dressings. *Wound Repair Regen.* **18**(2): 266-275.
- Cao, Y., dan Lin, H. C. 2021. Characterization and function of membrane vesicles in Gram-positive bacteria. *Applied Microbiology and Biotechnology.* **105**:1795 - 1801.
- Carnes, C. L., dan Klabunde, K. J. 2003. The catalytic methanol synthesis over nanoparticle metal oxide catalysts. *Journal of Molecular Catalysis A: Chemical.* **194**(1-2): 227-236.
- Dang, H. T., Lee, H. J., Yoo, E. S., Shinde, P. B., Lee, Y. M., Hong, J., Kim, D. K., dan Jung, J. H. 2008. Anti-inflammatory constituents of the red alga *Gracilaria verrucosa* and their synthetic analogues. *Journal of Natural Products.* **71**(2): 232-240.
- Darni, Y., Lismeri, L., Hanif, M., dan Putra, N. 2018 Pengaruh Bilangan Reynold pada Sintesis Bioplastik Berbasis Pati Sorgum dan Gelatin. *Prosiding Seminar Nasional Kulit, Karet dan Plastik ke-7.* 55-68.
- Dewi, K., Kartini, K., Sukweenadhi, J., dan Avanti, C. 2019. Karakter Fisik dan Aktivitas Antibakteri Nanopartikel Perak Hasil Green Synthesis Menggunakan Ekstrak Air Daun Sendok (*Plantago major L.*). *Pharmaceutical Sciences and Research.* **6**(2): 69-81.
- Din, M. I., dan Rehan, R. 2017. Synthesis, Characterization, and Applications of Copper Nanoparticles. *Analytical Letters.* **50**(1): 50-62.
- Edhirej, A., Sapuan, S. M., Jawaid, M., dan Ismarrubie Zahari, N. 2016. Preparation and Characterization of Cassava Starch/Peel Composite Film. *Polymer Composites.* **39**(5): 1704-1715.
- Ediyilyam, S., George, B., Shankar, S. S., Dennis, T. T., Waclawek, S., Černík, M., dan Padil,

- V. V. T. 2021. Chitosan/Gelatin/Silver Nanoparticles Composites Films for Biodegradable Food Packaging Applications. *Polymers*. **13**(11): 1-18.
- Elingo, M., Deepa, M., Subramanian, R., dan Mohamed Musthafa. 2017. Synthesis, Characterization, and Antibacterial Activity of Polyindole/Ag-CuO Nanocomposites by Reflux Condensation Method. *Polymer Plastic Technology and Engineering*. **57**(14): 1440-1451.
- Fadhila G.S, A. A., Darwis, W., Wibowo, R. H., Sipriyadi, S., dan Supriati, R. 2021. Antibacterial Activity of the Ethanolic Extract of Sembung Rambat (*Mikania micrantha Kunth*) Leaves Against *Bacillus subtilis*. *Natural Science: Journal of Science and Technology*. **1**(2): 141-149.
- Fiana, R. M., dan Asben, A. 2022. Pengaruh Konsentrasi Gliserol terhadap Karakter Fisik dan Kemampuan Antimikroba Edible Film Berbasis Pati Jagung dengan Penambahan Yogurt. *Jurnal Teknologi Pertanian Andalas*. **26**(1): 102-107.
- Freile-Pelegri n, Y., dan Murano, E. 2005. Agars from three species of *Gracilaria* (*Rhodophyta*) from Yucat n Peninsula. *Bioresour Technol*. **96**(3): 295-302.
- Frone, A. N., Berlioz, S., Chailan, J.-F., dan Panaitescu, D. M. 2013. Morphology and thermal properties of PLA–cellulose nanofibers composites. *Carbohydrate Polymers*. **91**(1): 377-384.
- Ghannadi, A., Shabani, L., dan Yegdaneh, A. 2016. Cytotoxic, antioxidant and phytochemical analysis of *Gracilaria* species from Persian Gulf. *Advanced Biomedical Research*. **5**(1): 1-5.
- Ghasemzadeh, H., Afraz, S., Moradi, M., dan Hassanpour, S. 2021. Antimicrobial chitosan-agarose full polysaccharide silver nanocomposite films. *International Journal of Biological Macromolecules*. **179**: 532-541.
- Gholinejad, M., dan Jeddi, N. 2014. Copper Nanoparticles Supported on Agarose as a Bioorganic and Degradable Polymer for Multicomponent Click Synthesis of 1,2,3-Triazoles under Low Copper Loading in Water. *ACS Sustainable Chemistry and Engineering*. **2**(12): 2658-2665.
- Gu, Y., Cheong, K. L., dan Du, H. 2017. Modification and comparison of three *Gracilaria* spp. agarose with methylation for promotion of its gelling properties. *Chemistry Central Journal*. **11**(104): 1-10.
- Hajipour, M. J., Fromm, K. M., Akbar Ashkarran, A., Jimenez de Aberasturi, D., Larramendi, I. R. d., Rojo, T., Serpooshan, V., Parak, W. J., dan Mahmoudi, M. 2012. Antibacterial properties of nanoparticles. *Trends in Biotechnology*. **30**(10): 499-511.
- Hasheminya, S.-M., dan Dehghannya, J. 2020. Green synthesis and characterization of copper nanoparticles using *Eryngium caucasicum* Trautv aqueous extracts and its antioxidant and antimicrobial properties. *Particulate Science and Technology*. **38**(8): 1019-1026.
- Hassanvand, H., dan Hashemi, P. 2018. Synthesis of Silver Nanoparticles-Agarose Composite and Its Application to the Optical Detection of Cyanide Ion. *Analytical Sciences*. **34**(5): 567-570.
- Husen, A & Daeng, R.A. 2018. Pengaruh Lama Penyimpanan terhadap Mutu Ikan Cakalang Asap (*Katsuwonus pelamis*). *Jurnal Ilmiah Agribisnis dan Perikanan (agrikan UMMU-Ternate)*. **11**(2): 59-64.
- Indriani, V., Chiuman, L., Wijaya, L., Lister, G., dan Grandis, L. 2020. Antibacterial Effect of Curcuma zedoaria Extract on *Bacillus cereus* and *Staphylococcus epidermidis*. *Althea Medical Journal*. **7**(1): 6-10.
- Jahan, I., Erci, F., Cakir-Koc, R., dan Isildak, I. 2020. Microwave-irradiated green synthesis of

- metallic silver and copper nanoparticles using fresh ginger (*Zingiber officinale*) rhizome extract and evaluation of their antibacterial potentials and cytotoxicity. *Inorganic and Nano-Metal Chemistry*. **51**(5): 722-732.
- Jamkhande, P. G., Ghule, N. W., Bamer, A. H., dan Kalaskar, M. G. 2019. Metal nanoparticles synthesis: An overview on methods of preparation, advantages and disadvantages, and applications. *Journal of Drug Delivery Sciences and Technology*. **53**(101174): 1-11.
- Jayarambabu Naradala, A. A., Venkatappa Rao Tumu, Rakesh Kumar Rajaboina. 2022. Antibacterial Activity of Copper Nanoparticles Synthesized by *Bambusa arundinacea* Leaves Extract. *Biointerface Research in Applied Chemistry*. **12**(1): 1230-1236.
- JIS (Japan Industrial Standard). 1975. *General Rules of Plastic Films for Food Packaging. Z 1707*. Japanese Standard Association. Tokyo.
- Kamsiati, E., Herawati, H., dan Yuli Purwani, E. 2017. Potensi Pengembangan Plastik Biodegradable Berbasis Pati Sagu dan Ubi Kayu di Indonesia. *Jurnal Penelitian dan Pengembangan Pertanian*. **36**(2): 67-76.
- Khani, R., Roostaei, B., Bagherzade, G., dan Moudi, M. 2018. Green synthesis of copper nanoparticles by fruit extract of *Ziziphus spina-christi* (L.) Willd.: Application for adsorption of triphenylmethane dye and antibacterial assay. *Journal of Molecular Liquids*. **255**: 541-549.
- Khanra, S., Mondal, M., Halder, G., Tiwari, O. N., Gayen, K., dan Bhowmick, T. K. 2018. Downstream processing of microalgae for pigments, protein and carbohydrate in industrial application: A review. *Food and Bioproducts Processing*. **110**: 60-84.
- Khatoon, U. T., Rao, G. V. S. N., dan Mohan, M. K. 2013, 24-26 July 2013. Synthesis and characterization of copper nanoparticles by chemical reduction method. *International Conference on Advanced Nanomaterials & Emerging Engineering Technologies, Chennai, India*. 11-14
- Khodashenas, B. 2016. The Influential Factors on Antibacterial Behaviour of Copper and Silver Nanoparticles. *Indian Chemical Engineer*. **58**(3): 224-239.
- Landangkasiang, A. I. N., Nurmelita, T., & Josefa, K. 2017. Kualitas Ikan Cakalang (*Katsuwonus pelamis* L.) Asap pada Beberapa Sentral Pengolahan di Sulawesi Utara. *Jurnal Media Teknologi Hasil Perikanan*. **5**(3): 86-89.
- Lee, W.-K., Lim, Y.-Y., Leow, A. T. C., Namasivayam, P., Abdullah, J. O., dan Ho, C.-L. 2016. Factors affecting yield and gelling properties of agar. *Journal of Applied Phycology*. **29**(3): 1527 - 1540.
- Lian, H., Shi, J., Zhang, X., dan Peng, Y. 2020. Effect of the added polysaccharide on the release of thyme essential oil and structure properties of chitosan based film. *Food Packaging and Shelf Life*. **23**(100467): 1-10.
- Longano, D., Ditaranto, N., Sabbatini, L., Torsi, L., dan Cioffi, N. 2011. *Synthesis and Antimicrobial Activity of Copper Nanomaterials*. In *Nano-Antimicrobials*. Berlin: Springer.
- Magani, A., Tallei, T., dan Kolondam, B. 2020. Uji Antibakteri Nanopartikel Kitosan terhadap Pertumbuhan Bakteri *Staphylococcus aureus* dan *Escherichia coli*. *Jurnal BIOS LOGOS*. **10**(1): 7-12.
- Mahmud, N., Islam, J., dan Tahergerabi, R. 2021. Marine Biopolymers: Applications in Food Packaging. *Processes*. **9**(12): 1-34.
- Martinah, S., Sutamihardja, R. T. M., dan Sugiarti, L. 2017. Optimasi Perlakuan Polyethylene Glikol (PEG) 6000 terhadap Isolasi Agarosa Rumput Laut *Glacilaria* sp. *Jurnal Sains Natural*. **4**(2): 115-128.
- Masykuroh, A., dan Puspasari, H. 2022. Aktivitas Antibakteri Nano Partikel Perak (NPP) Hasil

- Biosintesis Menggunakan Ekstrak Keladi Sarawak *Alocasia macrorrhizos* terhadap *Staphylococcus aureus* dan *Escherichia coli*. *BIOMA : Jurnal Biologi Makassar*. **7**(1): 76-85.
- Meena, R., Siddhanta, A. K., Prasad, K., Ramavat, B. K., Eswaran, K., Thirupathi, S. K., Ganesan, M., Mantri, V. A., dan Rao, P. V. S. 2007. Preparation, characterization and benchmarking of agarose from *Gracilaria dura* of Indian waters. *Carbohydrate Polymers*. **69**(1): 179-188.
- Moghadam, B. H., Hasanzadeh, M., dan Simchi, A. 2020. Self-Powered Wearable Piezoelectric Sensors Based on Polymer Nanofiber–Metal–Organic Framework Nanoparticle Composites for Arterial Pulse Monitoring. *ACS Applied Nano Materials*. **3**(9): 8742-8752.
- Mollet, J.-C., Rahaoui, A., dan Lemoine, Y. 1998. Yield, chemical composition and gel strength of agarocolloids of *Gracilaria gracilis*, *Gracilariopsis longissima* and the newly reported *Gracilaria cf. vermiculophylla* from Roscoff (Brittany, France). *Journal of Applied Phycology*. **10**: 59-66.
- Mustapa, M. A. 2014. *Tumbuhan Senyawa Penghambat Bakteri*. Ideas Publishing. Gorontalo.
- Mustaqim, N. A., Sapuan, S., dan R.A, I. 2021. Bio based polymer for food packaging application: A review. Conference: *Seminar on Advanced Bio and Mineral Based Natural Fiber Composites*, Malaysia. 62-66.
- Nalawati, A. N. 2015. *Sintesis Nanopartikel Perak (NPAg) dengan Metode yang Ramah Lingkungan dan Kajian Aktifitasnya dalam Menghambat Bakteri Gram Positif dan Bakteri Gram Negatif*. Tesis. Institut Pertanian Bogor. Bogor.
- Nigam, S., Das, A. K., dan Patidar, M. K. 2021. Synthesis, characterization and biodegradation of bioplastic films produced from *Parthenium hysterophorus* by incorporating a plasticizer (PEG600). *Environmental Challenges*. **5**(100280): 1-12.
- Njoki, P. N. 2019. Transformation of Silver Nanoparticles in Phosphate Anions: An Experiment for High School Students. *Journal of Chemical Education*. **96**(3): 546-552.
- Nugrahanto, A., Kurniawati, A., dan Erwanto, Y. 2021. Karakteristik fisis bioplastik yang dibuat dari kombinasi pati tapioka dan kasein susu apkir. *Majalah Kulit, Karet, dan Plastik*. **37**(2): 103-114.
- Nugraheni, R. W. 2012. *Aktivitas Antibakteri Ekstrak Etanol Rimpang Curcuma domestica dari Berbagai Daerah terhadap Bacillus cereus dan Klebsiella pneumoniae*. SKRIPSI. Surabaya: Universitas Airlangga.
- Nurhajar. 2021. *Pemanfaatan Rumput Laut (Gracilaria sp.) untuk Meningkatkan Pertumbuhan dan Sintasan Ikan Bandeng (Chanos chanos)*. Skripsi. Universitas Muhammadiyah Makassar. Makassar.
- Onofre-Cordeiro, N. A., Silva, Y. E. O., Solidônio, E. G., de Sena, K., Silva, W. E., Santos, B. S., Aquino, K. A. S., Lima, C. S. A., dan Yara, R. 2018. Agarose-silver particles films: Effect of calcium ascorbate in nanoparticles synthesis and film properties. *International Journal of Biological Macromolecules*. **119**: 701-707.
- Pacheco-Torgal, F. (2016). Introduction to biopolymers and biotech admixtures for eco-efficient construction materials. *Biopolymers and Biotech Admixtures for Eco-Efficient Construction Materials*. 1–10. doi:10.1016/b978-0-08-100214-8.00001-4
- Pande, M., dan Bhaskarwar, A. N. 2016. *Nanoparticles: Preparation and Characterization*. Momentum Press. Stanford.
- Pavoski, G., Baldisserotto, D. L. S., Maraschin, T., Brum, L. F. W., dos Santos, C., dos Santos, J. H. Z., Brandelli, A., dan Galland, G. B. 2019. Silver nanoparticles encapsulated in silica: Synthesis, characterization and application as antibacterial fillers in the ethylene

- polymerization. *European Polymer Journal*. **11**: 38-54.
- Perdones, Á., Chiralt, A., dan Vargas, M. 2016. Properties of film-forming dispersions and films based on chitosan containing basil or thyme essential oil. *Food Hydrocolloids*. **57**: 271-279.
- Prabhu, S., dan Poulouse, E. K. 2012. Silver nanoparticles: mechanism of antimicrobial action, synthesis, medical applications, and toxicity effects. *International Nano Letters*. **2**(32): 1-10.
- Pramasari, D. A., Sondari, D., Rachmawati, S. A., Ningrum, R. S., dan Sufiandi, S. 2021. The effect of alkaline-autoclaving delignification on chemical component changes of sugarcane trash. *IOP Conference Series: Earth and Environmental Science*. **759**(012010): 1-8.
- Prasetiowati, A. L., Prasetya, A. T., dan Wardani, S. 2018. Sintesis Nanopartikel Perak dengan Bioreduktor Ekstrak Daun Belimbing Wuluh (*Averrhoa Bilimbi L.*) sebagai Antibakteri. *Indonesian Journal of Chemical Science*. **7**(2): 160-166.
- Purnamasari, M. D., Harjono, H., dan Wijayati, N. 2016. Sintesis Antibakteri Nanopartikel Perak Menggunakan Bioreduktor Ekstrak Daun Sirih dengan Irradiasi Microwave. *Indonesian Journal of Chemical Science*. **5**(2): 152-158.
- Putri, S. E., Fudhail, A., dan Rauf, R. 2019. Pengaruh PVA terhadap kestabilan nanopartikel tembaga dari CuSO<sub>4</sub> menggunakan bioreduktor kulit buah naga merah (*Hylocereus costaricensis*). *Seminar Nasional Lembaga Penelitian Universitas Negeri Makassar*. 296-298.
- Rahayu, W. P., dan Arpah, M. 2004. *Pengetahuan Kemasan Plastik (Produk Industri Pangan dan Jasaboga)*. Institut Pertanian Bogor. Bogor.
- Rahmi, Q. F., Wulandari, E., dan Gumilar, J. 2022. Pengaruh Konsentrasi Gliserol pada Gelatin Kulit Kelinci terhadap Kadar Air, Ketebalan Film, dan Laju Transmisi Uap Air Edible Film. *Jurnal Teknologi Hasil Peternakan*. **3**(1): 19-31.
- Rajeshkumar, S., Menon, S., Venkat Kumar, S., Tambuwala, M. M., Bakshi, H. A., Mehta, M., Satija, S., Gupta, G., Chellappan, D. K., Thangavelu, L., dan Dua, K. 2019. Antibacterial and antioxidant potential of biosynthesized copper nanoparticles mediated through *Cissus arnotiana* plant extract. *Journal of Photochemistry and Photobiology B: Biology*, **197**(111531): 1-6.
- Rhim, J. W., Gennadios, A., Handa, A., Weller, C. L., dan Hanna, M. A. 2000. Solubility, tensile, and color properties of modified soy protein isolate films. *Journal of Agricultural and Food Chemistry*, **48**(10): 4937-4941.
- Rhim, J. W., Wang, L. F., dan Hong, S. I. 2013. Preparation and characterization of agar/silver nanoparticles composite films with antimicrobial activity. *Food Hydrocolloids* **33**(2): 327-335.
- Rusdi, M. 2017. Karakteristik Ukuran Partikel dan Indeks Polidispersitas Formulasi Nanoemulsi Pewarna Alam Ekstrak Kayu Secang (*Caesalpinia Sappan Linn*). *Jurnal Pertanian Terpadu*. **5**(2):114-127.
- Saleh, R. E., Juharni., & Zulaeha, M. 2018. Pendampingan Penentuan Umur Simpan Ikan Cakalang Fufu yang Dikemas Vakum di Home Industri Kelurahan Dufa-Dufa Ternate. *Jurnal Pengabdian Kepada Masyarakat*. **1**(1): 39-48.
- Salim, A., Nurhayati, N., dan Afriani, A. 2021. Aplikasi Edible Film Antimikroba Sebagai Kemasan Ramah Lingkungan Dalam Meningkatkan Kualitas Dan Daya Terima Bakso Ikan Tenggiri. *Jurnal Pembangunan Berkelanjutan*. **4**(1): 38 - 43.
- Santos, G. A. 1990. *A Manual for the Processing of Agar from Gracilaria*. Food and Agriculture Organization of the United Nations. Philippines.

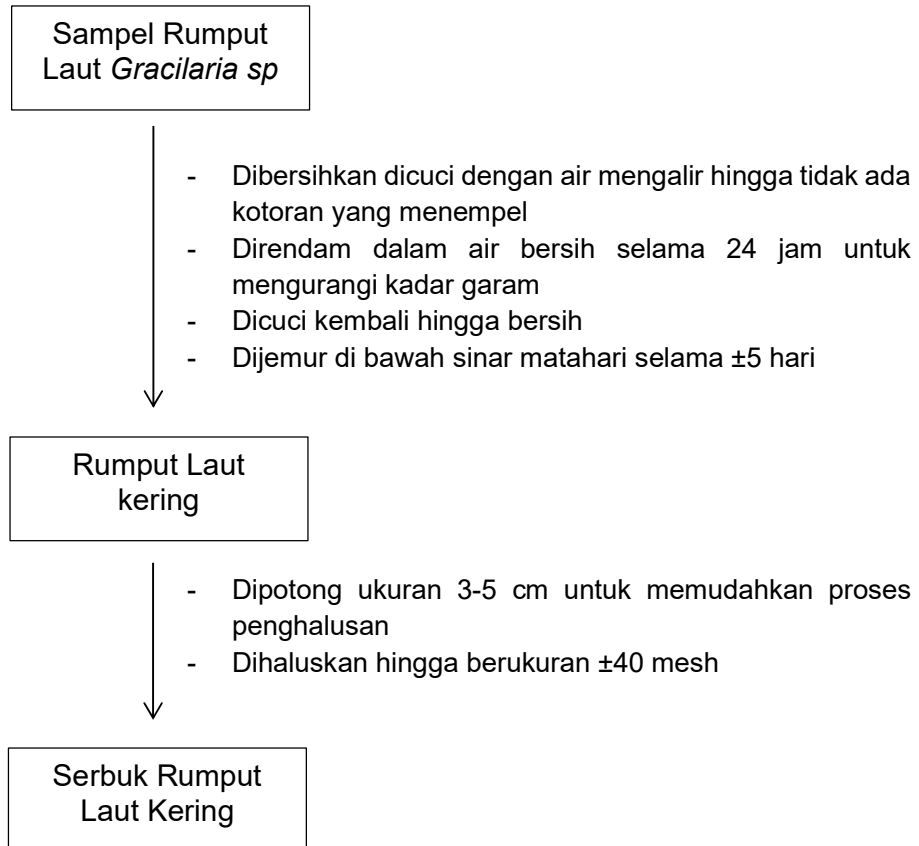
- Saravanan, B., dan Manivannan, V. 2018. Synthesis of Copper Nanoparticles using Trisodium Citrate and Evaluation of Antibacterial Activity. *Research Journal of Life Sciences, Bioinformatics, Pharmaceutical and Chemical Sciences*. **4**(5): 841-849.
- Satar, R., Izzhar, S. A., Rasool, M., Pushparaj, P. N., dan Ansari, S. A. 2016. Investigating the antibacterial potential of agarose nanoparticles synthesized by nanoprecipitation technology. *Polish Journal of Chemical Technology*. **18**(2): 12-19.
- Selpiana, Patricia, dan Anggraeni, C. P. 2016. Pengaruh Penambahan Kitosan dan Gliserol pada Pembuatan Bioplastik dari Ampas Tebu dan Ampas Tahu. *Jurnal Teknik Kimia*. **22**(1): 57-64.
- Shankar, S., Teng, X., dan Rhim, J.-W. 2014. Properties and characterization of agar/CuNP bionanocomposite films prepared with different copper salts and reducing agents. *Carbohydrate Polymers*. **114**: 484-492.
- Shao, Y., Wu, C., Wu, T., Yuan, C., Chen, S., Ding, T., Ye, X., dan Hu, Y. 2018. Green synthesis of sodium alginate-silver nanoparticles and their antibacterial activity. *International Journal of Biological Macromolecules*. **111**: 1281-1292.
- Sharma, M., Prakash Chaudhary, J., Mondal, D., Meena, R., dan Prasad, K. 2015. A green and sustainable approach to utilize bio-ionic liquids for the selective precipitation of high purity agarose from an agarophyte extract. *Green Chemistry*. **17**(5): 2867-2873.
- Shende, S., Ingle, A. P., Gade, A., dan Rai, M. 2015. Green synthesis of copper nanoparticles by *Citrus medica* Linn. (Idilimbu) juice and its antimicrobial activity. *World Journal of Microbiology and Biotechnology*. **31**(6): 865-873.
- Siracusa, V., Rocculi, P., Romani, S., dan Rosa, M. D. 2008. Biodegradable polymers for food packaging: a review. *Trends in Food Science and Technology*. **19**(12): 634-643.
- SNI. 2008. *SNI 2897:2008 : Metode pengujian cemaran mikroba dalam daging, telur dan susu, serta hasil olahannya*. Standar Nasional Indonesia. Jakarta.
- Sridhar, A., Ponnuchamy, M., Kumar, P. S., dan Kapoor, A. 2021. Food preservation techniques and nanotechnology for increased shelf life of fruits, vegetables, beverages and spices: a review. *Environmental Chemistry Letters*. **19**(2): 1715-1735.
- Sudibyo, A., dan Hutajulu, T. 2013. Potensi Penerapan Polimer Nanokomposit Dalam Kemasan Pangan. *Jurnal Kimia dan Kemasan*. **35**(1): 6-19.
- Surmawar, N. V., Thakare, S. R., dan Khaty, N. T. 2011. One-Pot, Single Step Green Synthesis of Copper Nanoparticles: SPR Nanoparticles. *International Journal of Green Nanotechnology*. **3**(4): 302-308.
- Suryanegara, L., Fatriasari, W., Zulfiana, D., Anita, S. H., Masruchin, N., Gutari, S., dan Kemala, T. 2021. Novel antimicrobial bioplastic based on PLA-chitosan by addition of TiO<sub>2</sub> and ZnO. *Journal of Environmental Health Science & Engineering*. **19**(1): 415-425.
- Suryati, Meriatna, dan Marlina. 2017. Optimasi Proses Pembuatan Bioplastik dari Pati Limbah Kulit Singkong. *Jurnal Teknologi Kimia Unimal*. **5**(1): 78-91.
- Tarhini, M., Benlyamani, I., Hamdani, S., Agusti, G., Fessi, H., Greige-Gerges, H., Bentaher, A., dan Elaissari, A. 2018. Protein-Based Nanoparticle Preparation via Nanoprecipitation Method. *Materials*. **11**(3): 1-18.
- Tessema, B., Gonfa, G., Hailegiorgis, S. M., Prabhu, S. V., dan Manivannan, S. 2023. Synthesis and characterization of silver nanoparticles using reducing agents of bitter leaf (*Vernonia amygdalina*) extract and tri-sodium citrate. *Nano-Structures and Nano-Objects*. **35**(100983): 1-9.
- Thiruvengadam, V., dan Bansod, A. 2020. Characterization of Silver Nanoparticles Synthesized using Chemical Method and its Antibacterial Property. *Biointerface*

- Research in Applied Chemistry*. **10**(6): 7257 - 7264.
- Tumonda, S., Hanny, W.M., & Samuel., M.T. 2017. Kajian Mutu Ikan Cakalang (Katsuwonus pelamis L.) Asap terhadap Nilai Kadar Air dan pH selama Penyimpanan. *Jurnal Media Teknologi Hasil Perikanan*. **5**(2): 158-162.
- Usman, M. S., El Zowalaty, M. E., Shameli, K., Zainuddin, N., Salama, M., dan Ibrahim, N. A. 2013. Synthesis, characterization, and antimicrobial properties of copper nanoparticles. *International Journal of Nanomedicine*. **8**(1): 4467-4479.
- Vuai, S. A. H., dan Mpatani, F. 2019. Optimization of agar extraction from local seaweed species, *Gracilaria salicornia* in Tanzania. *Phycological Research*. **67**(4): 261-266.
- Wahyudi, T., Sugiyana, D., dan Helmy, Q. 2011. Sintesis Nanopartikel Perak dan Uji Aktivitasnya terhadap Bakteri *E.Coli* dan *S. Aureus*. *Arena Tekstil*. **26**(1): 55-60.
- Wang, L., Hu, C., dan Shao, L. 2017. The antimicrobial activity of nanoparticles: present situation and prospects for the future. *International Journal of Nanomedicine*. **12**: 1227-1249.
- Wang, Z.-W., Zhu, M.-Q., Li, M.-F., Wei, Q., dan Sun, R.-C. 2019. Effects of hydrothermal treatment on enhancing enzymatic hydrolysis of rapeseed straw. *Renewable Energy*, **134**: 446-452.
- Wigunarti, A. H., Pujiyanto, S., dan Supriyadi, A. 2019. Uji Aktivitas Antibakteri Ekstrak Biji Kelor (*Moringa oleifera L.*) Terhadap Pertumbuhan Bakteri *Staphylococcus aureus* dan Bakteri *Escherichia coli*. *Berkala Bioteknologi*. **2**(2): 1-12.
- Wijayanti, K. P. 2018 Bio-degradable Bioplastics sebagai Plastik Ramah Lingkungan. *Surya Octagon Interdisciplinary Journal of Technology*. **1**(1): 131-153.
- Wisnuwardhani, H. A., Roosma, A., Lukmayani, Y., Arumsari, A., dan Sukanta. 2019. Optimasi Kondisi Sintesis Nanopartikel Tembaga menggunakan Ekstrak Biji Melinjo (*Gnetum gnemon L.*). *Jurnal Ilmiah Ibnu Sina (JIIS): Ilmu Farmasi dan Kesehatan*. **4**(2): 353-360.
- Zakir, M., Maming, M., Lembang, M. S., dan Lembang, E. Y. 2021. Reduction mechanisms of Ag(I) and Au(III) in the synthesis of silver and gold nanoparticles using leaf extract of *Terminalia catappa*. *Jurnal Natural*. **21**(2): 89-98.
- Zarrintaj, P., Manouchehri, S., Ahmadi, Z., Saeb, M. R., Urbanska, A. M., Kaplan, D. L., dan Mozafari, M. 2018. Agarose-based biomaterials for tissue engineering. *Carbohydrate Polymers*. **187**: 66-84.
- Zhang, Y., Fu, X., Duan, D., Xu, J., dan Gao, X. 2019. Preparation and characterization of agar, agarose, and agaropectin from the red alga *Ahnfeltia plicata*. *Journal of Oceanology and Limnology*. **37**(3): 815-824.
- Zhang, Y., He, X., Li, J., Zhang, H., dan Gao, X. 2007. Gas-sensing properties of hollow and hierarchical copper oxide microspheres. *Sensors and Actuators B: Chemical*. **128**(1): 293-298.
- Zulham, A., & Subaryono. 2017. *Rekomendasi Pengembangan Perikanan Tangkap di Ternate dan Sekitarnya*. PT Raja Grafindo Persada. Depok.



## Lampiran 1. Bagan Kerja Penelitian

### A. Preparasi Sampel



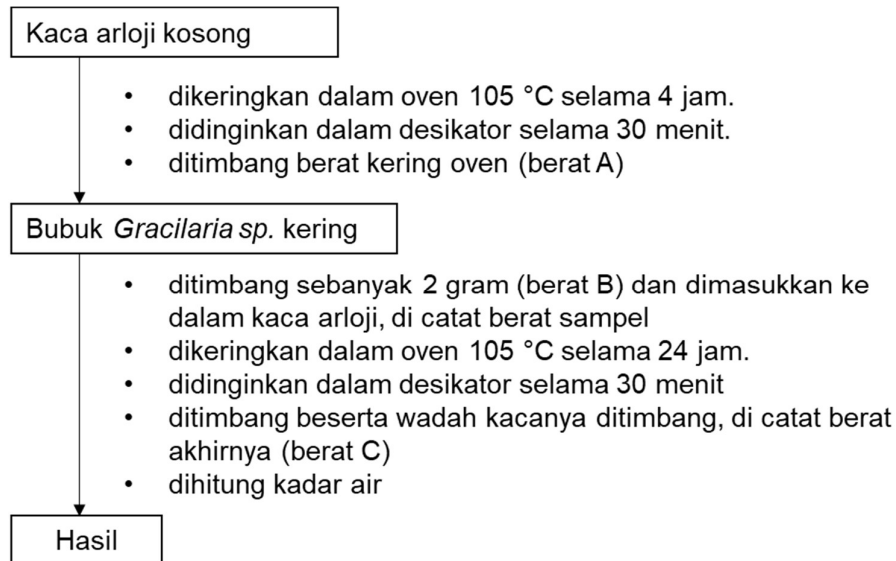
Hasil:



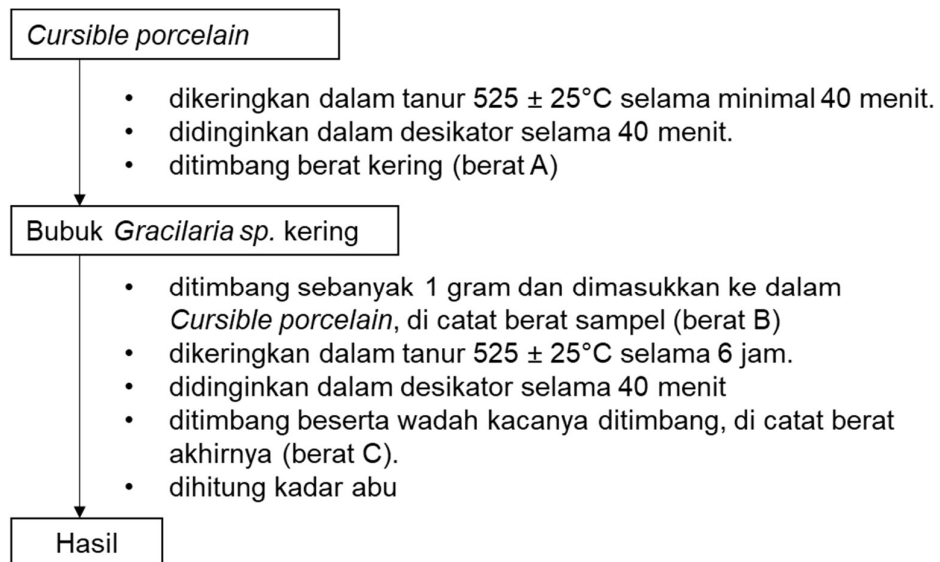
Sampel *Gracilaria sp.* kering berukuran  $\pm 40$  mesh

## B. Uji Komponen Kimia *Gracilaria sp.*

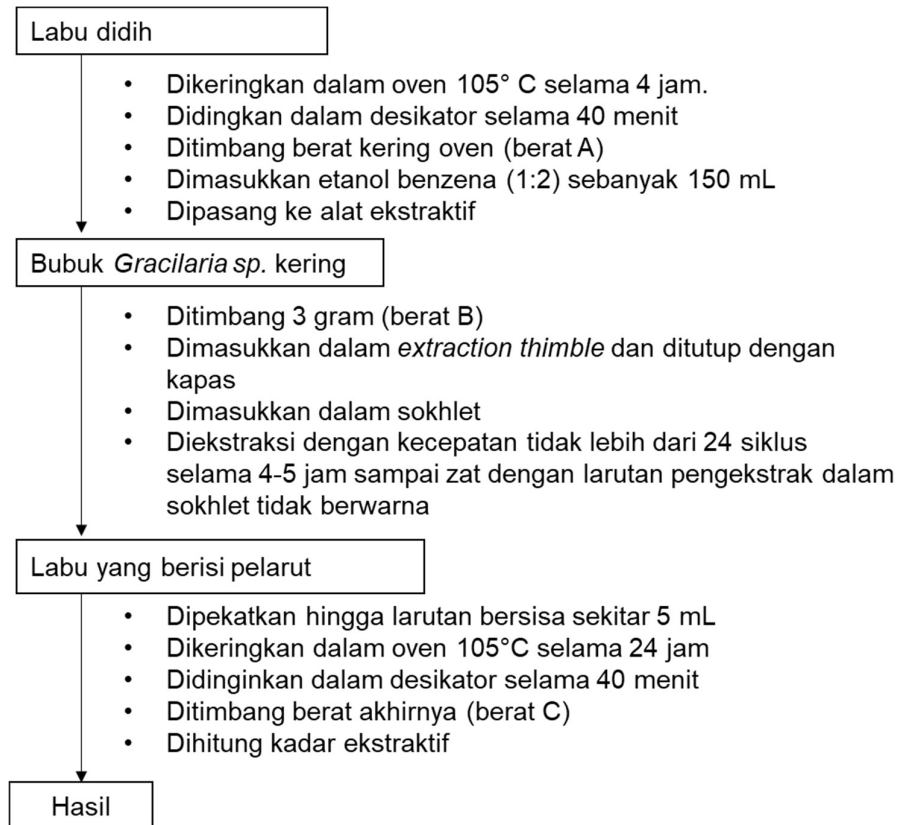
### 1. Uji Kadar Air



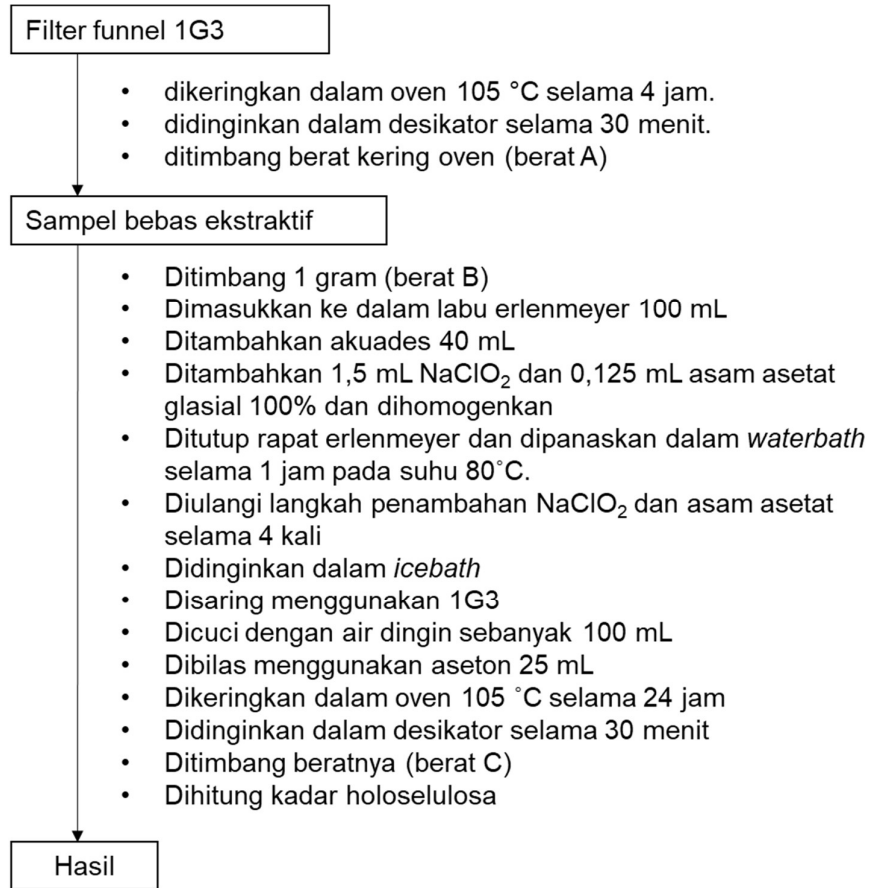
### 2. Uji Kadar Abu



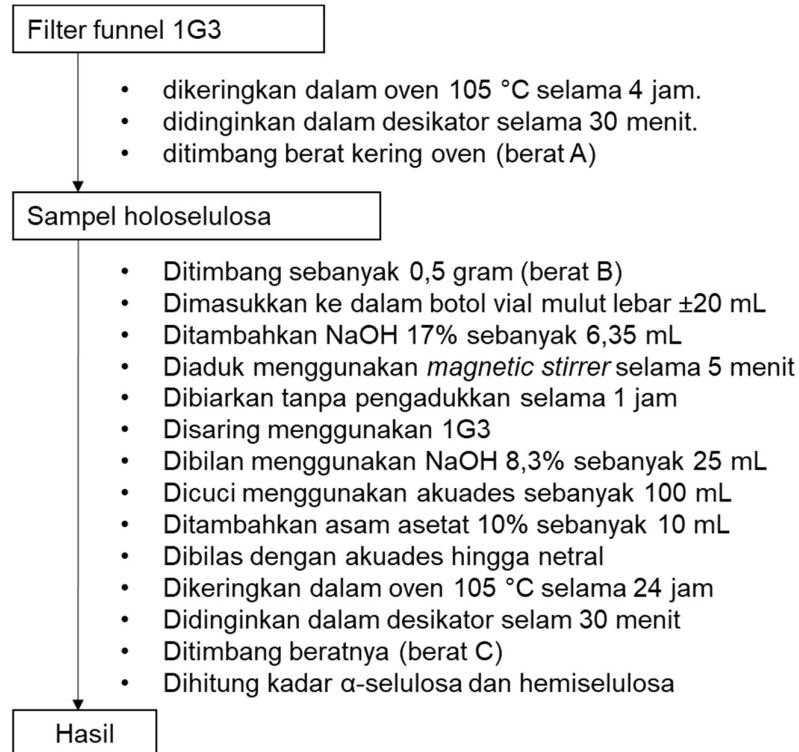
### 3. Uji Kadar Ekstraktif



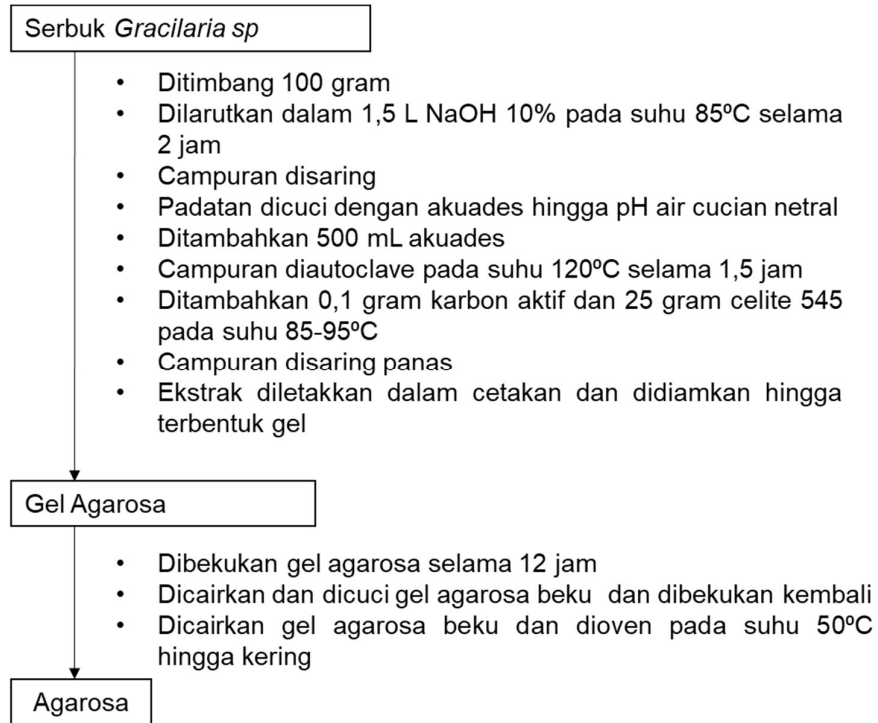
#### 4. Uji Kadar Holoselulosa



## 5. Uji Kadar $\alpha$ -Selulosa dan Hemiselulosa



### C. Isolasi Agarosa dari *Gracilaria sp.*



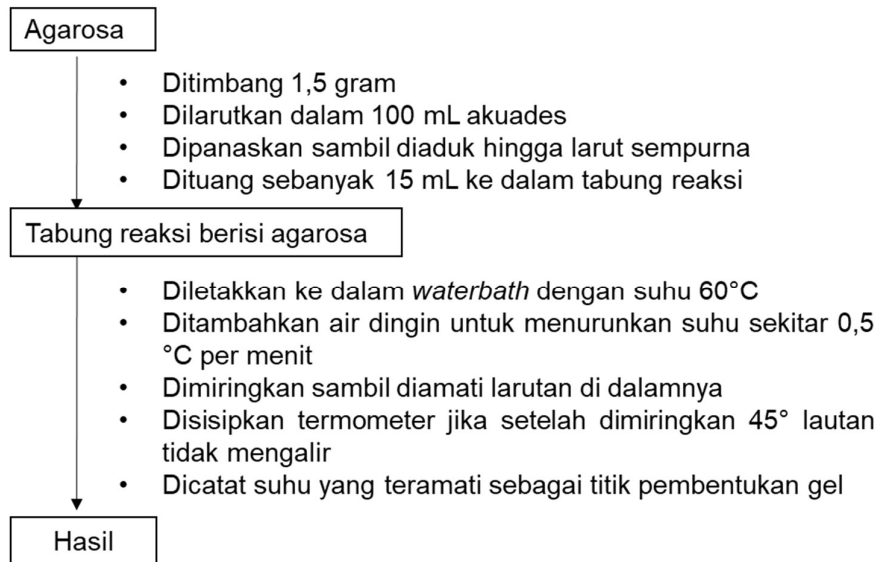
#### Hasil:



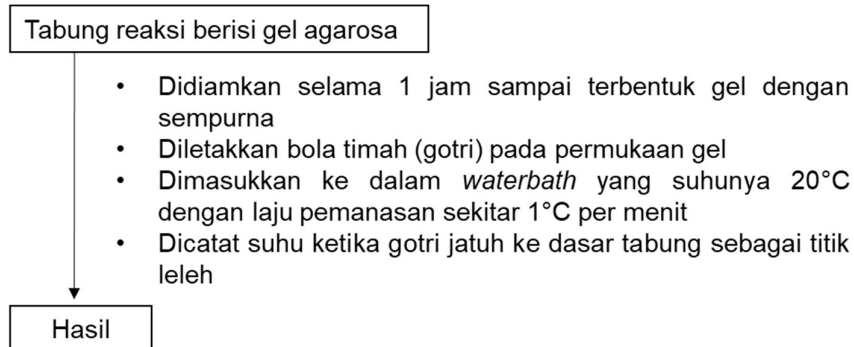
Agarosa dengan warna putih

## D. Uji Kualitas Agarosa

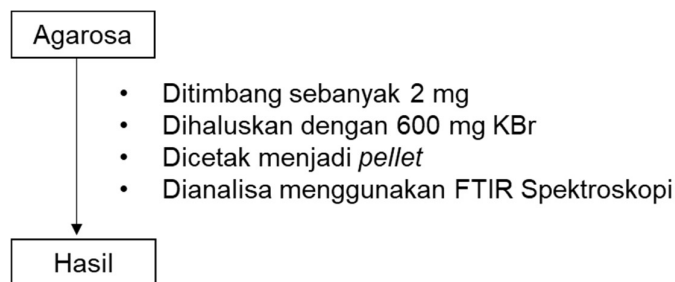
### 1. Uji Penentuan Titik Pembentukan Gel



### 2. Uji Penentuan Titik Leleh

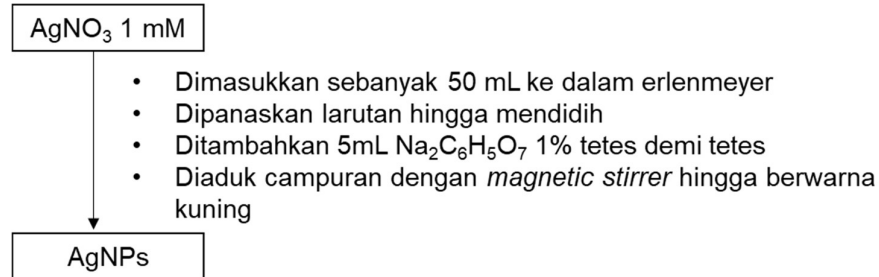


### 3. Pengukuran Spektrum IR

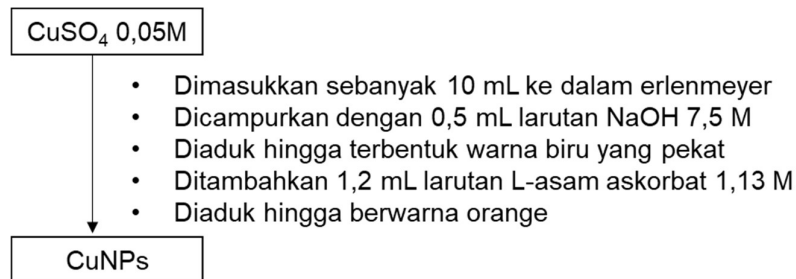


## E. Sintesis Nanopartikel Logam

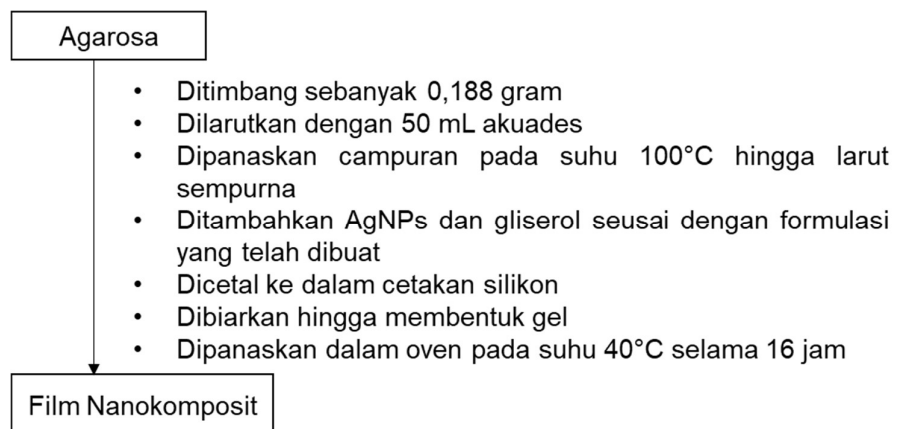
### 1. Sintesis AgNPs



### 2. Sintesis CuNPs



## F. Sintesis Film Nanokomposit Logam-Agarosa





## G. Uji Aktivitas Antibakteri

Bakteri uji sebanyak 1 ose

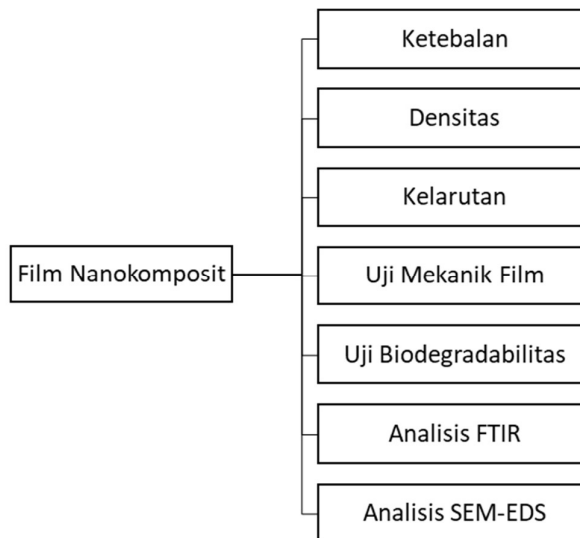
- Diinokulasikan ke dalam 20 mL NB (*Nutrient Broth*) dalam 100 mL Erlenmeyer.
- Suhu  $37 \pm 2$  °C digunakan untuk inkubasi kultur dengan kecepatan shaker 110 rpm selama 18-24 jam.

Sebanyak 1% (v/v)

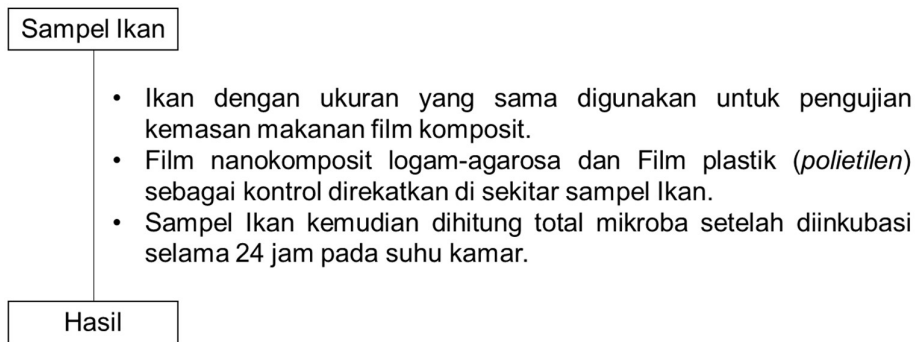
- Dari setiap inokulum bakteri yang mengandung  $1 \times 10^7$ - $1 \times 10^8$  CFU/mL sel bakteri dimasukkan ke dalam media NA (*Nutrient Agar*) steril yang masih cair ( $\pm 40$  °C)
- Dihomogenkan dengan vortex kemudian dituang ke dalam cawan petri sebanyak  $\pm 20$  mL.
- Setelah media NA di dalam cawan petri padat, film nanokomposit yang sudah dipotong berbentuk bulat dengan diameter 0,5 cm ditempelkan di atas permukaan media NA.
- Semua cawan uji diinkubasi di dalam inkubator suhu 37°C selama 24 jam
- Aktivitas antibakteri ditentukan dengan mengukur zona bening yang terbentuk setiap 2 jam

Aktivitas antibakteri

## H. Karakterisasi Film Nanokomposit



## I. Uji Potensi Kemampuan Film Nanokomposit sebagai Kemasan Antibakteri



## Lampiran 2. Analisis Data Penelitian

### A. Komponen Kimia *Gracilaria* sp.

KADAR AIR <i>Gracilaria</i> sp.						
Kode	Gelas Kaca/g (A)	Berat sampel (g)	Gelas Kaca + Sampel (g)	Kadar Air (%)	Rata-rata KA	Stdev
A	13,6146	1,9998	15,3169	14,8765	15,1871	0,44
B	13,2297	2,0003	14,9200	15,4977		

KADAR ABU <i>Gracilaria</i> sp.							
Kode	Porcelin Kosong (g)	Berat Sampel (g)	BKO (g)	Porcelin + Sampel (g)	Kadar Abu (%)	Rata2	Stdev
A	45,4356	1,0020	0,8498	45,5198	9,9079	9,9668	0,08
B	44,1562	1,0040	0,8515	44,2414	10,0256		

KADAR EKSTRAKTIF DALAM ALKOHOL-BENZENA								
Kode	KA	Labu didih (g)	Berat Sampel (g)	BKO (g)	Berat Kering Oven labu didih + zat ekstraktif+ batu didih	Kadar Ekstraktif (%)	Rata2	Stdev
A	15,1871	105,7967	3,0000	2,5444	106,0350	9,3657	20,8298	0,80
B		115,4336	3,0001	2,5445	115,978	21,3954		
C		105,0582	3,0000	2,5444	105,5738	20,2642		

KADAR LIGNIN TIDAK TERLARUT ASAM																
Kode	KA	1G3 Oven	Sampel	BKO	1G3 + AIR	AIL (g)	AIL (%)	Porcelin	Sampel AIR	Porselin & Abu	Persen Abu (%)	Abu AIR (g)	AIL (g)	AIL (%)	Rata2	Stdev
A	9,1621	32,3692	0,3002	0,2727	32,3763	0,0071	2,3598	44,5705	0,0779	44,6457	96,5340	0,0069	0,0002	0,0902	0,165918278	0,11
B		31,803	0,3003	0,2728	31,8086	0,0056	1,6142	46,8477	0,0085	46,8552	88,2353	0,0049	0,0007	0,2416		

KA AIL dan Holoselulosa				
Berat Gelas (g)	Berat sampel (g)	Kering Oven Gelas Kaca + Sampel (g)	Kadar Air (%)	Rata2 KA
13,1401	0,3002	13,4124	9,2938	9,1621
13,0415	0,3001	13,3145	9,0303	

KADAR LIGNIN TERLARUT ASAM (ASL)					
Kode	Absorbansi pada 205 nm	Pengenceran (x)	Kadar ASL (%)	Rata2	Stdev
A	0,379	20	9,6432	8,8799	1,08
B	0,319	20	8,1166		

HOLOSELULOSA								
Kode	KA (%)	IG3 (g)	Sampel (g)	BKO (g)	IG3 & Holoselulosa (g)	Kadar Holoselulosa (%)	Rata2	Stdev
A	9,1621	31,8111	1,0107	0,9181	31,9787	16,5454	15,7754	1,09
B		32,379	1,0161	0,9230	32,5552	15,0055		

KADAR ALFA SELULOSA DAN HEMISELULOSA											
Kode	KA (%)	IG3	Sampel	BKO	IG3 & Alfa Selulosa	Kadar alfa selulosa	Rata2	Stdev	Kadar Hemiselulosa (%)	Rerata	Stdev
A	5,5641	31,9131	0,1083	0,10227	31,9706	9,3021	8,9405	0,51	7,2433	6,8349	0,58
B		31,256	0,1115	0,10530	31,3162	8,5790			6,4265		

0,5295

KA ALFA SELULOSA				
Berat Gelas (g)	Berat Sampel (g)	Kering Oven Gelas Kaca + Sampel (g)	Kadar Air (%)	Rata2 KA
13,0344	0,0916	13,1211	5,3493	5,5641
13,1564	0,0796	13,2314	5,7789	

Komponen Kimia	Jumlah	SD
Kadar Air	15,2	0,44
Kadar Abu	10,0	0,08
Kadar Ekstraktif	20,8	0,80
Kadar ALL	0,2	0,11
Kadar ASL	8,9	1,08
Kadar Holoselulosa	15,8	1,09
$\alpha$ -selulosa	8,9	0,51
Hemiselulosa	6,8	0,58

## B. Isolasi Agarosa

### 1. Pembuatan larutan NaOH 10% (b/v)

$$\text{massa NaOH} = \frac{10\% \text{ g/mL} \times 1000 \text{ mL}}{100\% \text{ mL/mL}} = 100 \text{ g}$$

### 2. Rendemen Agarosa

$$\text{Rendemen} = \frac{\text{berat agarosa}}{\text{berat rumput laut}} \times 100\%$$

$$\text{Rendemen} = \frac{4,51 \text{ g}}{250 \text{ g}} \times 100\%$$

$$\text{Rendemen} = 1,8 \%$$

## C. Kandungan Sulfat Agarosa



KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN  
**INSTITUT PERTANIAN BOGOR**  
 UNIT LABORATORIUM JASA PENGUJIAN, KALIBRASI DAN SERTIFIKASI  
 Sertifikat Akreditasi KAN No. LP-156-IDN ; LK-336-IDN ; LSP-439-IDN ; LSHACCP-009-IDN ; LSSMKP-009-IDN

Gedung Pascasarjana Wing Kimia Lantai Dasar  
 Kampus IPB Baranangsiang, Jl. Pajajaran Bogor 16129  
 Phone 0251-8319894, 8323571 Website : www.ilab-ipb.org  
 Email : labterpadu@apps.ipb.ac.id

FR-20.2-LT-1.0	<b>LABORATORY TEST REPORT</b>	Page 1 of 1
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Certificate No. : LT-10-22-0635  
 Laboratory No. : BM/VI/22/1424  
 Sample Matrix : Agar Powder\*  
 Sample Id : Sampel 1 NaOH 10%

Received Date : 13-06-2022  
 Finished Date : 21-06-2022

Parameter	Result	Unit	Method
Sulfate, SO <sub>4</sub>	2878.32	mg/Kg	APHA 23 <sup>rd</sup> (2017) : 4500-SO <sub>4</sub> <sup>2-</sup> E

REMARKS:  
 \*) Outside the scope of accreditation  
 Laboratory is not responsible for the sampling process

June 21, 2022  
 Head of Laboratory

Dr. Mohammad Khoib, M.Si  
 NIP. 19781018 200701 1 002

ppm	Abs	Abs terkoreksi
0,000	0,141	0,000
0,500	0,142	0,001
1,000	0,148	0,007
2,000	0,157	0,016
4,000	0,178	0,037
6,000	0,201	0,060
8,000	0,221	0,080
10,000	0,240	0,099

blk	abs	Abs terkoreksi	FP	ppm SO <sub>4</sub>	rerata ppm SO <sub>4</sub>	SO <sub>4</sub>	
0,121	0,148	0,027	1	2,9129	2,9129	BM1424(0.1012g/100mL)	2878,321 mg/Kg
	0,148	0,027	1	2,9129		BM1424(0.1012g/100mL)-2	0,29 %w/w
	0,148	0,027	1	2,9129		BM1424(0.1012g/100mL)-Avg	

a	-0,002850
b	0,010248
R	0,999172
R <sup>2</sup>	0,998345

#### D. Sifat Fisik dan Kandungan Sulfat Agarosa

##### DATA SIFAT FISIK AGAROSA *Thermo Scientific*

Parameter	1	2	3	Rata-Rata	SD	Keterangan
Melting point	90	89	90	90	0,6	1.5% Gel
Gel point	34,5	34	35	35	0,5	1.5% Gel
Kadar Sulfat				0,10%		

##### DATA SIFAT FISIK AGAROSA *Gracilaria sp.*

Parameter	1	2	3	Rata-Rata	SD	Keterangan
Titik leleh	90	93	90	91	1,7	1.5% Gel
Titik pembentukan gel	36	37	36,5	36,5	0,5	1.5% Gel
Kadar Sulfat				0,29%		

## DATA FISIK AGAROSA

Jenis Agarosa	Rendemen (%)	Titik Pembentukan gel (°C) *	Titik leleh(°C) *	Kadar Sulfat (%)	Keterangan
<i>Gracilaria sp</i>	1,8	36	91	0,29	Penelitian ini
<i>Euchema cottoni</i>	0,65	-	96	0,26	Aslinda dan Ahmad, 2016
<i>Gracilaria dura</i>	23	35	-	0,25	Meena, 2007
** <i>Gracilaria verrucosa</i>	9,2	34	90	0,32	Abidin, dkk., 2015
Thermo Scientific	-	35	90	0,1***	Penelitian ini
Takara	-	-	98	0,14	Aslinda dan Ahmad, 2016
Sigma Aldrich	-	33.5-36.5	85.5-88.5	0,3	**** A9668

(\*) 1,5% gel

(\*\*) Metode presipitasi Propilen Glikol dengan perlakuan NaOH 10%

(\*\*\*) Katalog Thermo Scientific



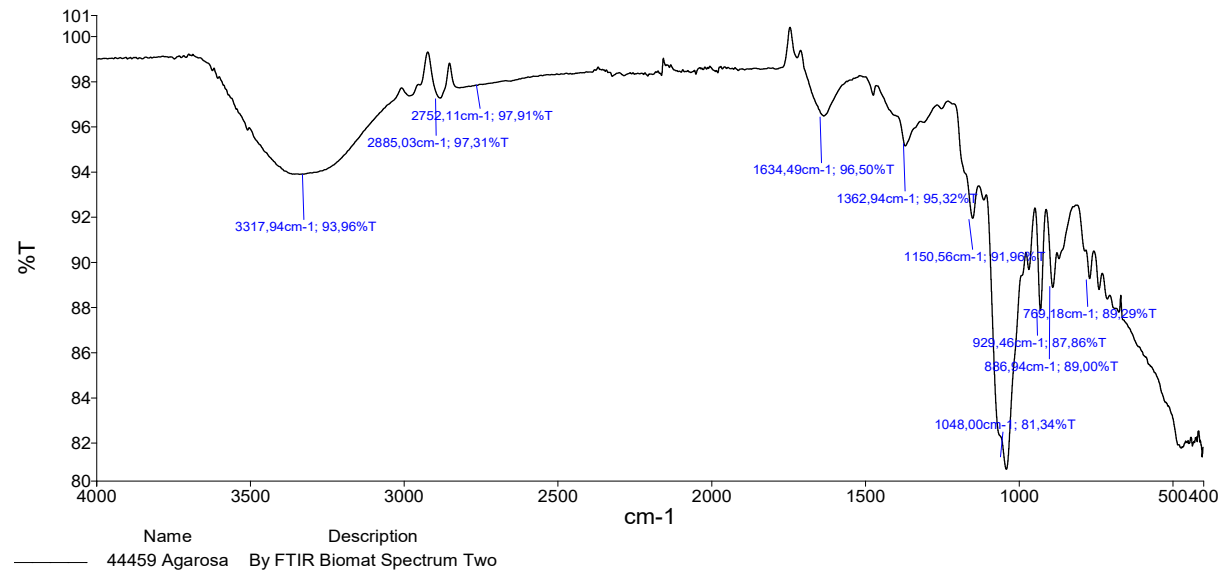
## Hasil FTIR Agarosa

Agarosa dari *Gracilaria sp*

### 44459 Agarosa

Peak Number	X (cm-1)	Y (%T)
-------------	----------	--------

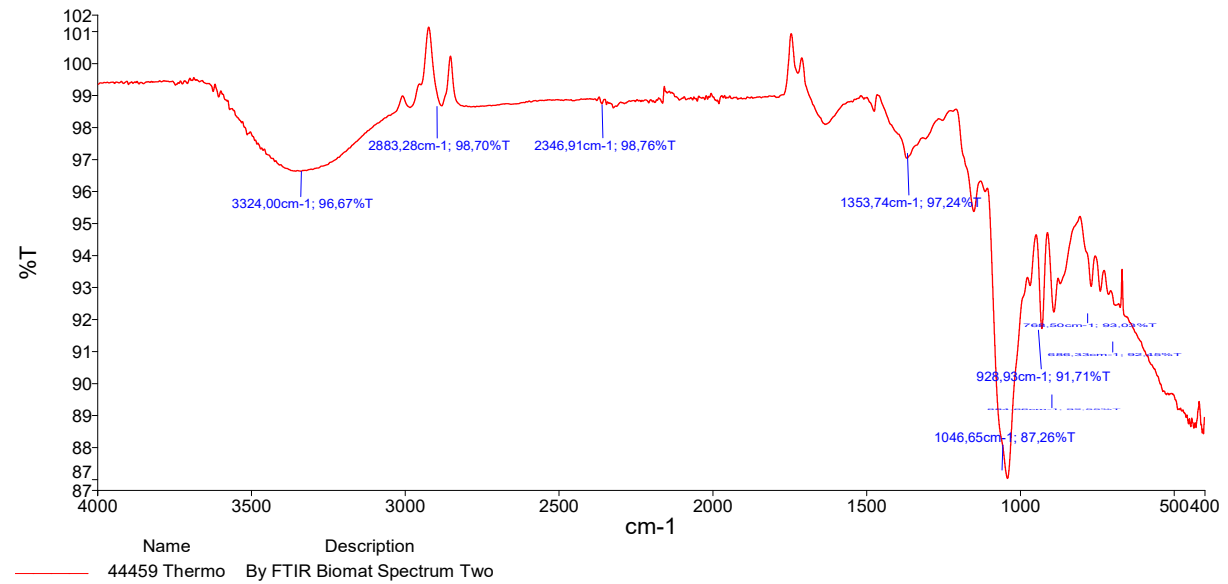
1	3317,94	93,96
2	2885,03	97,31
3	2752,11	97,91
4	1634,49	96,50
5	1362,94	95,32
6	1150,56	91,96
7	1048,00	81,34
8	929,46	87,86
9	886,94	89,00
10	769,18	89,29



## Agarosa dari Thermo Scientific

## 44459 Thermo

Peak Number	X (cm-1)	Y (%T)
1	3324,00	96,67
2	2883,28	98,70
3	2346,91	98,76
4	1353,74	97,24
5	1046,65	87,26
6	928,93	91,71
7	884,66	92,55
8	768,50	93,03
9	686,33	92,45



**E. Pembuatan Nanopartikel Logam****1. Pembuatan larutan AgNO<sub>3</sub> 1mM**

$$\text{massa AgNO}_3 = \frac{0,001\text{M} \times 169,87 \text{ g/mol} \times 50 \text{ mL}}{1000}$$

$$\text{massa AgNO}_3 = 0,0085 \text{ g}$$

**2. Pembuatan larutan Na<sub>3</sub>C<sub>6</sub>H<sub>5</sub>O<sub>7</sub> 1%**

$$\text{massa Na}_3\text{C}_6\text{H}_5\text{O}_7 = \frac{1\% \times 50 \text{ mL}}{100\%}$$

$$\text{massa Na}_3\text{C}_6\text{H}_5\text{O}_7 = 0,5 \text{ g}$$

**3. Pembuatan larutan CuSO<sub>4</sub> 0,05M**

$$\text{massa CuSO}_4 = \frac{0,05\text{M} \times 160 \text{ g/mol} \times 50 \text{ mL}}{1000}$$

$$\text{massa CuSO}_4 = 0,4 \text{ g}$$

**4. Pembuatan larutan NaOH 7,5 M**

$$\text{massa NaOH} = \frac{7,5\text{M} \times 40 \text{ g/mol} \times 10 \text{ mL}}{1000}$$

$$\text{massa NaOH} = 3 \text{ g}$$

**5. Pembuatan larutan L-Asam Askorbat 1,13 M**

$$\text{massa L – asam askorbat} = \frac{1,13\text{M} \times 176 \text{ g/mol} \times 10 \text{ mL}}{1000}$$

$$\text{massa L – asam askorbat} = 1,99 \text{ g}$$

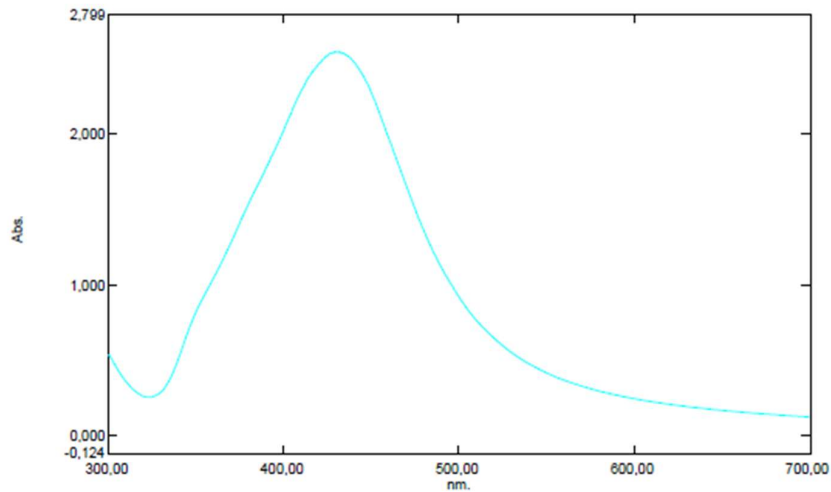
## 6. Hasil Uji Spektrofotometri UV-Vis

### - Hasil Spektrum UV-Vis AgNPs

#### Spectrum Peak Pick Report

30/06/2022 15:35:58

Data Set: AgNP\_151826 - RawData



[Measurement Properties]  
 Wavelength Range (nm.): 300.00 to 700.00  
 Scan Speed: Medium  
 Sampling Interval: 0.5  
 Auto Sampling Interval: Enabled  
 Scan Mode: Auto

No.	P/V	Wavelength	Abs.	Description
1	●	429.50	2.555	
2	●	322.50	0.251	

[Instrument Properties]  
 Instrument Type: UV-1800 Series  
 Measuring Mode: Absorbance  
 Slit Width: 1.0 nm  
 Light Source Change Wavelength: 340.0 nm  
 S/R Exchange: Normal

[Attachment Properties]  
 Attachment: None

[Operation]  
 Threshold: 0.0010000  
 Points: 4  
 InterPolate: Disabled  
 Average: Disabled

[Sample Preparation Properties]  
 Weight:  
 Volume:  
 Dilution:  
 Path Length:  
 Additional Information:

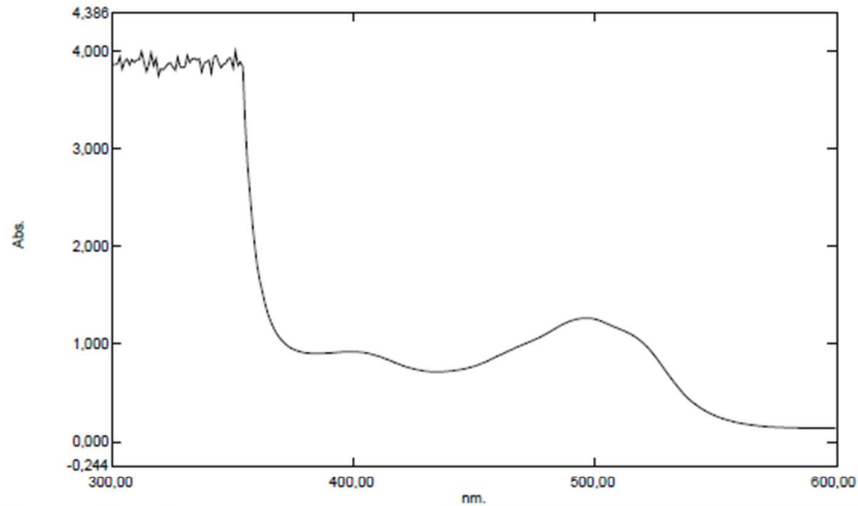
Puncak serapan tertinggi pada **429,5 nm**

- Hasil Spektrum UV-Vis CuNPs

## Spectrum Peak Pick Report

06/09/2022 13:08:56

Data Set: cunps2\_125406 - RawData



[Measurement Properties]  
 Wavelength Range (nm.): 300.00 to 600.00  
 Scan Speed: Medium  
 Sampling Interval: 1.0  
 Auto Sampling Interval: Disabled  
 Scan Mode: Auto

[Instrument Properties]  
 Instrument Type: UV-1800 Series  
 Measuring Mode: Absorbance  
 Slit Width: 1.0 nm  
 Light Source Change Wavelength: 340.0 nm  
 S/R Exchange: Normal

[Attachment Properties]  
 Attachment: None

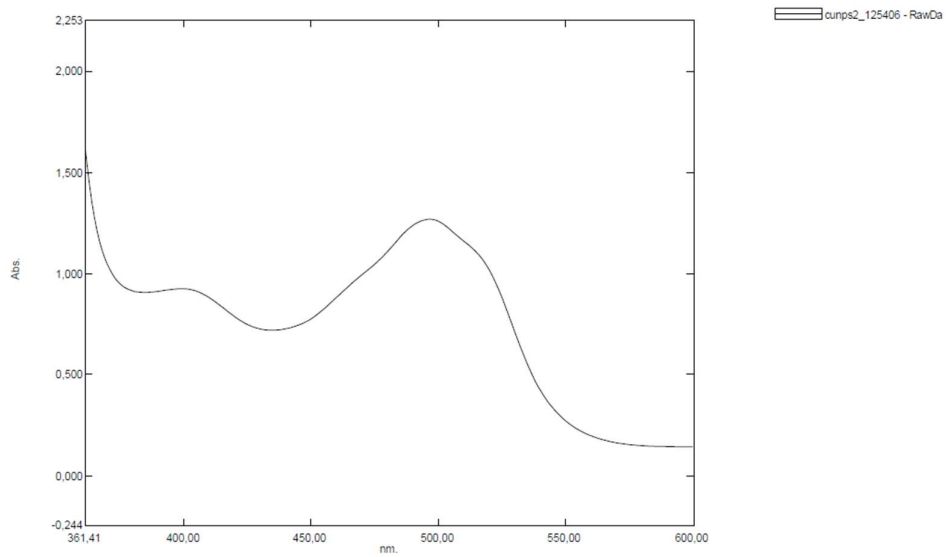
[Operation]  
 Threshold: 0.0010000  
 Points: 4  
 InterPolate: Disabled  
 Average: Disabled

[Sample Preparation Properties]  
 Weight:  
 Volume:  
 Dilution:  
 Path Length:  
 Additional Information:

No.	P/V	Wavelength	Abs.	Description
1	⬆	497.00	1.269	
2	⬆	399.00	0.925	
3	⬆	351.00	4.000	
4	⬆	435.00	0.719	
5	⬆	385.00	0.908	

## Overlay Spectrum Graph Report

06/09/2022 13:09:16



Page 1 / 1

Puncak serapan tertinggi pada **497 nm**

## 7. Hasil Uji PSA



PT NANOTECH INDONESIA GLOBAL Tbk



### REPORT OF ANALYSIS

Date: 21 - 03 - 2023

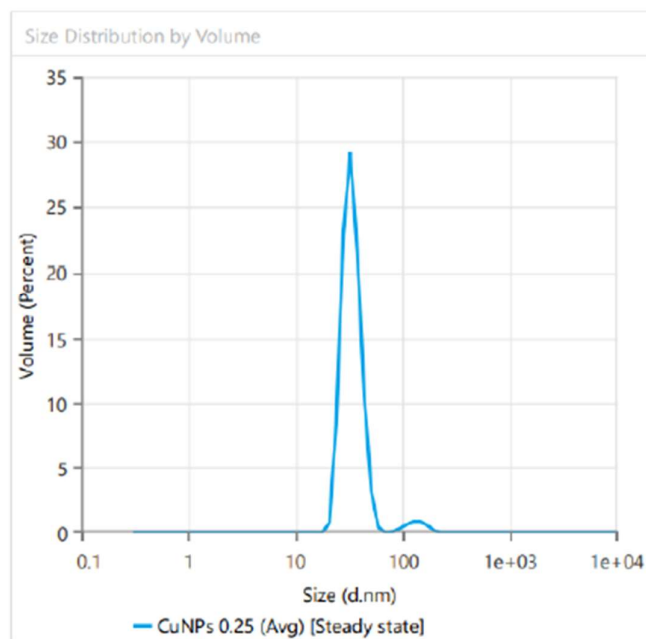
Report No. : 003/ROA-NIG/III/2023

Applicant : Rahmaniah Zainuddin

Name of Sample : CuNPs dan AgNPs

#### Analisis Hasil Uji Particle Size Analyzer (PSA)

#### Grafik PSA Sampel CuNPs



#### Kondisi Pengujian

Temperatur : 25 °C

Nama pelarut : Air

Indeks refraksi : 1,33

Viskositas : 0,887 cP

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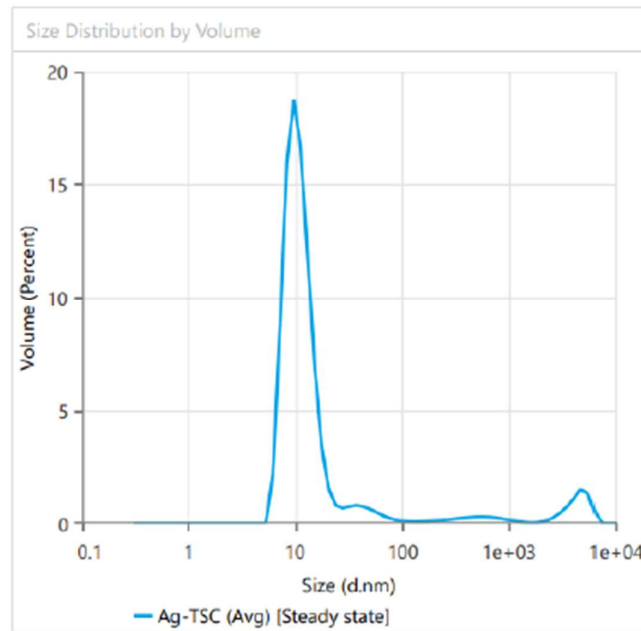
Gedung Nanoplex  
Jl. Raya Puspiptek Serpong, Ko. Batan Lama A-12  
Setu, Tangerang Selatan, Banten - 15314



**Hasil Distribusi Ukuran**

Peak	Diameter (nm)	Persentase
1	31,14	99,94
2	121	0,06
3	0	0
4	0	0
5	0	0

*Polydispersity Index: 0,4824*

**Grafik PSA Sampel AgNPs**

**Kondisi Pengujian**

Temperatur : 25 °C  
 Nama pelarut : Air  
 Indeks refraksi : 1,33  
 Viskositas : 0,887 cP





PT NANOTECH INDONESIA GLOBAL Tbk



#### Hasil Distribusi Ukuran

Peak	Diameter (nm)	Persentase
1	106,6	100
2	0	0
3	0	0
4	0	0
5	0	0

*Polydispersity Index: 0,4773*

#### Analisis

Setelah dilakukan pengecekan ukuran partikel menggunakan Malvern Zetasizer. Diketahui bahwa sampel Copper Nanoparticles Colloid memiliki ukuran partikel sebesar 31,14 nm sebanyak 99,94% dan 121 nm sebanyak 0,06% serta memiliki nilai *Polydispersity Index* (PI) 0,4824 yang menunjukkan sampel homogen. Sementara itu, sampel Silver Nanoparticles Colloid memiliki ukuran partikel sebesar 106,6 nm sebanyak 100% serta nilai PI 0,4773 yang menunjukkan sampel homogen.



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Gedung Nanoplex  
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Setu, Tangerang Selatan, Banten - 15314





Pseudomonas

Sampel	Zona Bening Jam ke-																																															
	2				4				6				8				10				12				14				16				18				20				22				24			
	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2	1	2	3	Rata2				
Ag (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Ag (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Ag (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Cu (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Cu (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Cu (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
K+ (kloramfenikol 300 ppm)	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	15,0	13,0	14,0	14,0	15,0	14,0	14,0	14,3	15,0	16,0	16,0	15,7	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0				

Ket: Bakteri belum tumbuh

S. Aureus

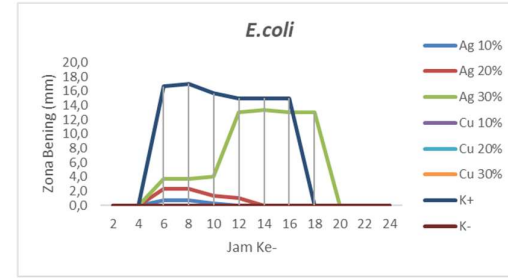
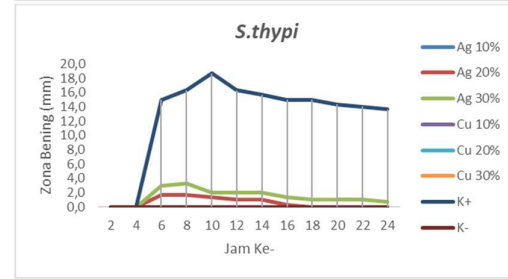
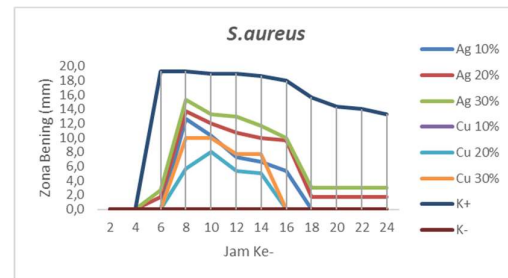
Sampel	Zona Bening Jam ke-											
	2	4	6	8	10	12	14	16	18	20	22	24
Ag (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	12,7	10,3	7,3	6,7	5,3	0,0	0,0	0,0	0,0
Ag (20%) + Agarosa + Gli 1%	0,0	0,0	1,7	13,7	12,0	10,7	10,0	9,7	1,7	1,7	1,7	1,7
Ag (30%) + Agarosa + Gli 1%	0,0	0,0	2,7	15,3	13,3	13,0	11,7	10,0	3,0	3,0	3,0	3,0
Cu (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	5,7	8,0	5,3	5,0	0,0	0,0	0,0	0,0	0,0
Cu (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	10,0	10,0	7,7	7,7	0,0	0,0	0,0	0,0	0,0
K+ (kloramfenikol 300 ppm)	0,0	0,0	19,3	19,3	19,0	19,0	18,7	18,0	15,7	14,3	14,0	13,3
K-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

S.Thyphi

Sampel	*											
	2	4	6	8	10	12	14	16	18	20	22	24
Ag (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ag (20%) + Agarosa + Gli 1%	0,0	0,0	1,7	1,7	1,3	1,0	1,0	0,3	0,0	0,0	0,0	0,0
Ag (30%) + Agarosa + Gli 1%	0,0	0,0	3,0	3,3	2,0	2,0	2,0	1,3	1,0	1,0	1,0	0,7
Cu (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
K+ (kloramfenikol 300 ppm)	0,0	0,0	15,0	16,3	18,7	16,3	15,7	15,0	15,0	14,3	14,0	13,7
K-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

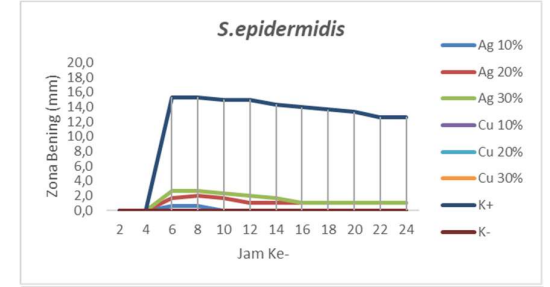
E. Coli

Sampel	Zona Bening Jam ke-											
	2	4	6	8	10	12	14	16	18	20	22	24
Ag (10%) + Agarosa + Gli 1%	0,0	0,0	0,7	0,7	0,3	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ag (20%) + Agarosa + Gli 1%	0,0	0,0	2,3	2,3	1,3	1,0	0,0	0,0	0,0	0,0	0,0	0,0
Ag (30%) + Agarosa + Gli 1%	0,0	0,0	3,7	3,7	4,0	13,0	13,3	13,0	13,0	0,0	0,0	0,0
Cu (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
K+ (kloramfenikol 300 ppm)	0,0	0,0	16,7	17,0	15,7	15,0	15,0	15,0	0,0	0,0	0,0	0,0
K-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0



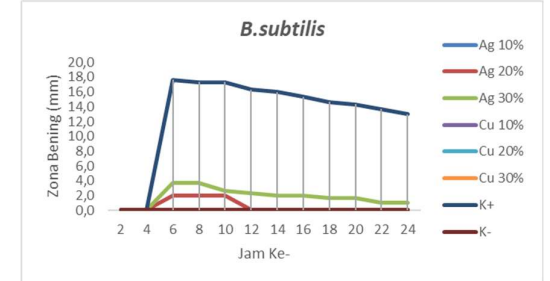
**S. Epidermidis**

Sampel	Zona Bening Jam ke-											
	2	4	6	8	10	12	14	16	18	20	22	24
Ag (10%) + Agarosa + Gli 1%	0,0	0,0	0,7	0,7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ag (20%) + Agarosa + Gli 1%	0,0	0,0	1,7	2,0	1,7	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Ag (30%) + Agarosa + Gli 1%	0,0	0,0	2,7	2,7	2,3	2,0	1,7	1,0	1,0	1,0	1,0	1,0
Cu (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
K+ (kloramfenikol 300 ppm)	0,0	0,0	15,3	15,3	15,0	15,0	14,3	14,0	13,7	13,3	12,7	12,7
K-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0



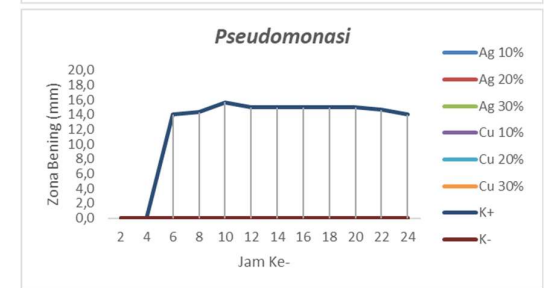
**B. Subtilis**

Sampel	Zona Bening Jam ke-											
	2	4	6	8	10	12	14	16	18	20	22	24
Ag (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ag (20%) + Agarosa + Gli 1%	0,0	0,0	2,0	2,0	2,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ag (30%) + Agarosa + Gli 1%	0,0	0,0	3,7	3,7	2,7	2,3	2,0	2,0	1,7	1,7	1,0	1,0
Cu (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
K+ (kloramfenikol 300 ppm)	0,0	0,0	17,7	17,3	17,3	16,3	16,0	15,3	14,7	14,3	13,7	13,0
K-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0



**Pseudomonas**

Sampel	Zona Bening Jam ke-											
	2	4	6	8	10	12	14	16	18	20	22	24
Ag (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ag (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Ag (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (10%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (20%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Cu (30%) + Agarosa + Gli 1%	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
K+ (kloramfenikol 300 ppm)	0,0	0,0	14,0	14,3	15,7	15,0	15,0	15,0	15,0	15,0	14,7	14,0
K-	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0



## G. Karakterisasi Kemasan Antibakteri

### 1. Ketebalan

Jenis Film	1	2	3	4	5	Ketebalan Rata2	SD
Agarosa	0,02	0,02	0,03	0,03	0,03	0,03	0,01
Agarosa+Ag	0,03	0,04	0,05	0,04	0,04	0,04	0,01
Agarosa+Cu	0,04	0,04	0,05	0,04	0,05	0,04	0,01
Agarosa+Gli 0.5%	0,05	0,04	0,04	0,05	0,05	0,05	0,01
Agarosa+Ag+Gli 0.5%	0,05	0,07	0,06	0,06	0,06	0,06	0,01
Agarosa+Cu+Gli 0.5%	0,06	0,05	0,04	0,04	0,04	0,05	0,01
Agarosa+Gli1%	0,06	0,05	0,08	0,06	0,06	0,06	0,01
Agarosa+Ag+1%	0,09	0,08	0,10	0,09	0,09	0,09	0,01
Agarosa+Cu+1%	0,08	0,07	0,09	0,07	0,07	0,08	0,01

### 2. Densitas

Jenis Film	1					2					3					Densitas Rata2	SD
	panjang	lebar	tinggi	massa	Densitas	panjang	lebar	tinggi	massa	Densitas	panjang	lebar	tinggi	massa	Densitas		
Agarosa	2,00	2,00	0,00	0,01	0,68	2,00	2,00	0,00	0,01	0,73	2,00	2,00	0,00	0,01	0,63	0,68	0,05
Agarosa+Ag	2,00	2,00	0,01	0,01	0,54	2,00	2,00	0,01	0,01	0,59	2,00	2,00	0,01	0,01	0,52	0,55	0,04
Agarosa+Cu	2,00	2,00	0,00	0,02	1,07	2,00	2,00	0,00	0,02	1,03	2,00	2,00	0,00	0,02	0,99	1,03	0,04
Agarosa+Gli 0.5%	2,00	2,00	0,00	0,01	0,51	2,00	2,00	0,00	0,01	0,48	2,00	2,00	0,00	0,01	0,52	0,50	0,02
Agarosa+Ag+Gli 0.5%	2,00	2,00	0,00	0,01	0,77	2,00	2,00	0,00	0,01	0,80	2,00	2,00	0,00	0,01	0,73	0,77	0,04
Agarosa+Cu+Gli 0.5%	2,00	2,00	0,00	0,02	1,13	2,00	2,00	0,00	0,02	1,17	2,00	2,00	0,00	0,02	1,12	1,14	0,02
Agarosa+Gli1%	2,00	2,00	0,01	0,01	0,55	2,00	2,00	0,01	0,02	0,63	2,00	2,00	0,01	0,02	0,61	0,60	0,04
Agarosa+Ag+1%	2,00	2,00	0,01	0,02	0,50	2,00	2,00	0,01	0,02	0,44	2,00	2,00	0,01	0,02	0,46	0,47	0,03
Agarosa+Cu+1%	2,00	2,00	0,01	0,03	0,93	2,00	2,00	0,01	0,02	0,73	2,00	2,00	0,01	0,03	0,85	0,83	0,10

### 3. Kelarutan

Jenis Film	Ulangan 1			Ulangan 2			Ulangan 3			Rata2	SD
	m1	m2	% penurunan berat sampel	m1	m2	% penurunan berat sampel	m1	m2	% penurunan berat sampel		
Agarosa	0,01	0,01	8,57	0,01	0,01	9,23	0,01	0,01	9,02	8,94	0,34
Agarosa+Gli 0.5%	0,01	0,01	22,22	0,01	0,01	22,03	0,01	0,01	22,76	22,34	0,38
Agarosa+Gli1%	0,02	0,01	58,46	0,02	0,01	61,14	0,02	0,01	59,14	59,58	1,39
Agarosa+Ag	0,01	0,01	20,00	0,01	0,01	21,00	0,01	0,01	21,83	20,94	0,92
Agarosa+Ag+Gli 0.5%	0,01	0,01	36,81	0,01	0,01	36,76	0,02	0,01	34,81	36,13	1,14
Agarosa+Ag+Gli1%	0,02	0,01	59,23	0,02	0,01	59,82	0,02	0,01	59,05	59,37	0,40
Agarosa+Cu	0,02	0,01	43,79	0,02	0,01	42,77	0,02	0,01	43,60	43,39	0,54
Agarosa+Cu+Gli 0.5%	0,02	0,01	55,50	0,02	0,01	55,33	0,02	0,01	54,89	55,24	0,31
Agarosa+Cu+Gli1%	0,03	0,01	69,18	0,03	0,01	69,44	0,03	0,01	69,38	69,34	0,14

### 4. Uji Biodegradabilitas

#### Ulangan 1

Jenis Film	Pengamatan 1 (7 hari)			Pengamatan 2 (14 hari)		
	m1	m2	% penurunan berat sampel	m1	m2	% penurunan berat sampel
Agarosa	0,0071	0,0037	47,8873	0,0071	0,0000	100,0000
Ag 10% + Agarosa	0,0093	0,0062	33,3333	0,0093	0,0021	77,4194
Ag 20% + Agarosa	0,0136	0,0090	33,8235	0,0136	0,0081	40,4412
Ag 30% + Agarosa	0,0195	0,0138	29,2308	0,0195	0,0137	29,7436
Cu 10% + Agarosa	0,0137	0,0087	36,4964	0,0137	0,0015	89,0511
Cu 20% + Agarosa	0,0181	0,0118	34,8066	0,0181	0,0098	45,8564
Cu 30% + Agarosa	0,0282	0,0189	32,9787	0,0282	0,0173	38,6525

**Ulangan 2**

Jenis Film	Pengamatan 1 (7 hari)			Pengamatan 2 (14 hari)		
	m1	m2	% penurunan berat sampel	m1	m2	% penurunan berat sampel
Agarosa	0,0076	0,0039	48,6842	0,0076	0,0000	100,0000
Ag 10% + Agarosa	0,0088	0,0057	35,2273	0,0088	0,0019	78,4091
Ag 20% + Agarosa	0,0141	0,0093	34,0426	0,0141	0,0082	41,8440
Ag 30% + Agarosa	0,0201	0,0139	30,8458	0,0201	0,0138	31,3433
Cu 10% + Agarosa	0,0157	0,0101	35,6688	0,0157	0,0018	88,5350
Cu 20% + Agarosa	0,0160	0,0105	34,3750	0,0160	0,0089	44,3750
Cu 30% + Agarosa	0,0221	0,0148	33,0317	0,0221	0,0138	37,5566

**Ulangan 3**

Jenis Film	Pengamatan 1 (7 hari)			Pengamatan 2 (14 hari)		
	m1	m2	% penurunan berat sampel	m1	m2	% penurunan berat sampel
Agarosa	0,0065	0,0033	49,2308	0,0065	0,0000	100,0000
Ag 10% + Agarosa	0,0096	0,0063	34,3750	0,0096	0,0022	77,0833
Ag 20% + Agarosa	0,0128	0,0085	33,5938	0,0128	0,0075	41,4063
Ag 30% + Agarosa	0,0193	0,0135	30,0518	0,0193	0,0134	30,5699
Cu 10% + Agarosa	0,0152	0,0097	36,1842	0,0152	0,0019	87,5000
Cu 20% + Agarosa	0,0164	0,0106	35,3659	0,0164	0,0089	45,7317
Cu 30% + Agarosa	0,0257	0,0171	33,4630	0,0257	0,0158	38,5214

**Uji Biodegradabilitas**

Jenis Film	Pengamatan 1 (7 hari)		Pengamatan 2 (14 hari)	
	%	SD	%	SD
Agarosa	49	1	100	0
Ag 10% + Agarosa	34	1	78	1
Ag 20% + Agarosa	34	0	41	1
Ag 30% + Agarosa	30	1	31	1
Cu 10% + Agarosa	36	0	88	1
Cu 20% + Agarosa	35	0	45	1
Cu 30% + Agarosa	33	0	38	1



## 5. Uji Mekanik

### Agarosa

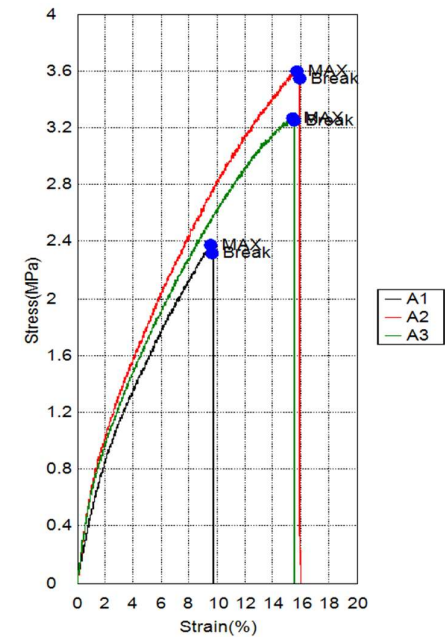
Report Date	12/12/2022	Test Date	12/12/2022
Testing Machine	AGS-X	Capacity	5000N
Test Mode	Single	Test Type	Tensile
Speed	10mm/min	Shape	Plate
No of Batches:	1	Qty/Batch:	3

### Data Dimensi

Name	Thickness	Width	Gauge_Length
Unit	mm	mm	mm
A1	0,05	20,32	48,16
A2	0,06	20,61	47,79
A3	0,05	22,14	49,16

### Data Hasil Uji

Name	Mod Elastic	Tensile Strenght	Max_Strain	Break_Strain	Max_Force
Parameters	Stress 0 – 3 MPa		Calc. at Entire Areas	Sensitivity: 0.3	Calc. at Entire Areas
Unit	GPa	N/mm2	%	%	N
A1	0,026	2,37	9,59	9,70	4,01
A2	0,031	3,60	15,75	15,95	5,28
A3	0,027	3,27	15,41	15,52	5,32
Average	0,028	3,08	13,59	13,72	4,87
Standard Deviation	0,003	0,63	3,46	3,49	0,74



**Ag-Agarosa**

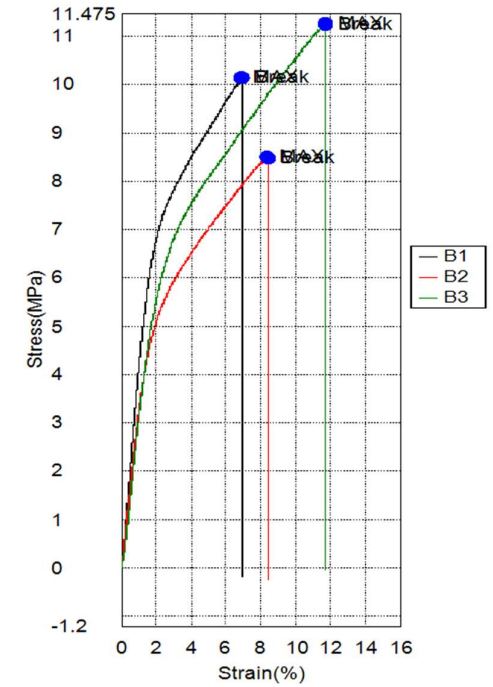
<b>Report Date</b>	12/12/2022	<b>Test Date</b>	12/12/2022
<b>Testing Machine</b>	AGS-X	<b>Capacity</b>	5000N
<b>Test Mode</b>	Single	<b>Test Type</b>	Tensile
<b>Speed</b>	10mm/min	<b>Shape</b>	Plate
<b>No of Batches:</b>	1	<b>Qty/Batch:</b>	3

**Data Dimensi**

Name	Thickness	Width	Gauge_Length
Unit	mm	mm	mm
B1	0,05	20,69	47,92
B2	0,07	21,47	49,28
B3	0,05	21,13	48,98

**Data Hasil Uji**

Name	Mod Elastic	Tensile Strenght	Max_Strain	Break_Strain	Max_Force
Parameters	Stress 1 - 5 MPa		Calc. at Entire Areas	Sensitivity: 0.3	Calc. at Entire Areas
Unit	GPa	N/mm2	%	%	N
B1	0,419	10,15	6,88	6,90	10,31
B2	0,248	8,51	8,38	8,40	10,53
B3	0,303	11,27	11,70	11,72	12,47
Average	0,323	9,98	8,99	9,01	11,10
Standard Deviation	0,087	1,39	2,46	2,47	1,19



**Cu-Agarosa**

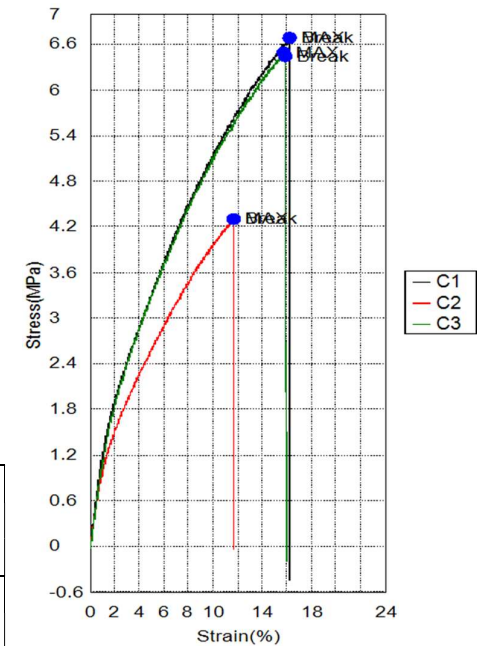
<b>Report Date</b>	12/12/2022	<b>Test Date</b>	12/12/2022
<b>Testing Machine</b>	AGS-X	<b>Capacity</b>	5000N
<b>Test Mode</b>	Single	<b>Test Type</b>	Tensile
<b>Speed</b>	10mm/min	<b>Shape</b>	Plate
<b>No of Batches:</b>	1	<b>Qty/Batch:</b>	3

**Data Dimensi**

Name	Thickness	Width	Gauge_Length
Unit	mm	mm	mm
C1	0,08	21,11	49,31
C2	0,07	20,96	49,84
C3	0,08	20,34	50,17

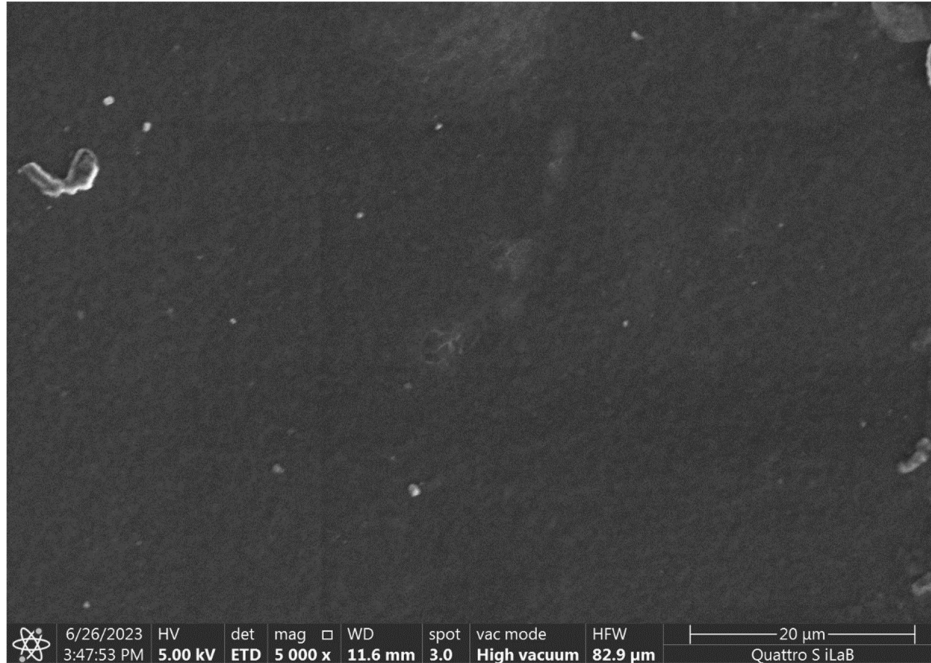
**Data Hasil Uji**

Name	Mod Elastic	Tensile Strenght	Max_Strain	Break_Strain	Max_Force
Parameters	Stress 0 – 2 MPa		Calc. at Entire Areas	Sensitivity: 0.3	Calc. at Entire Areas
Unit	GPa	N/mm2	%	%	N
C1	0,065	6,68	16,22	16,22	6,91
C2	0,042	4,30	11,69	11,69	6,46
C3	0,066	6,49	15,75	15,94	6,85
Average	0,058	5,82	14,55	14,62	6,74
Standard Deviation	0,014	1,32	2,49	2,54	0,25

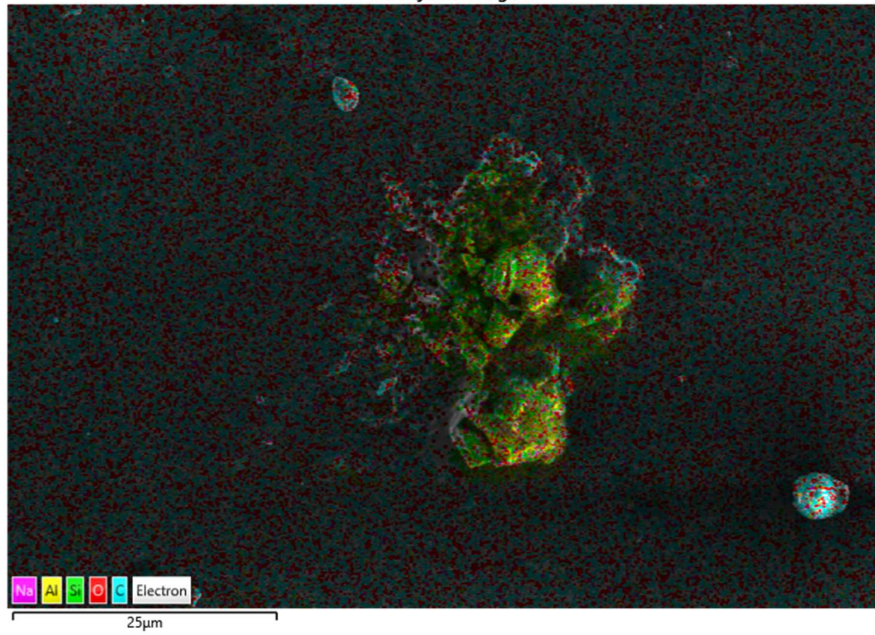


## 6. Uji SEM-EDS

### Film Agarosa

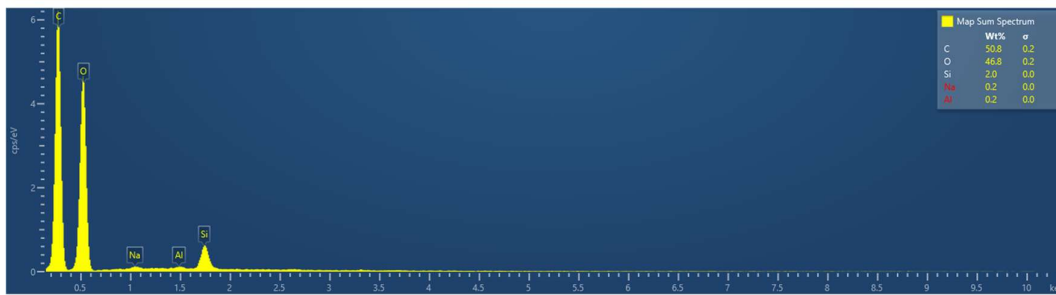


EDS Layered Image 1



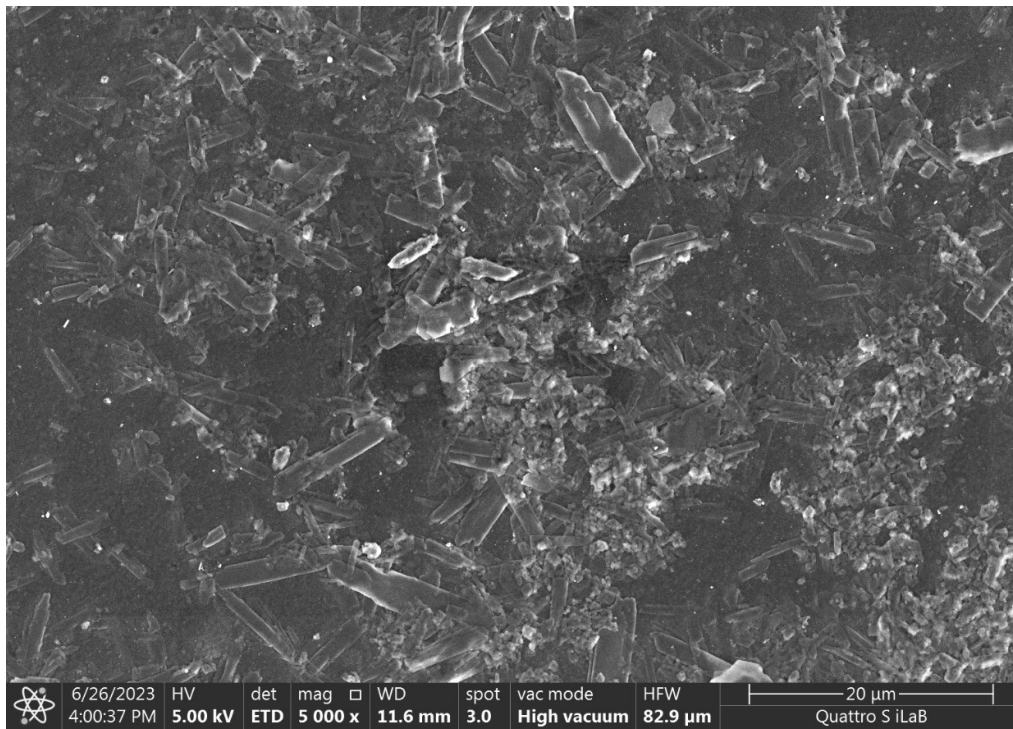
Budi saksono-87418

26/06/2023

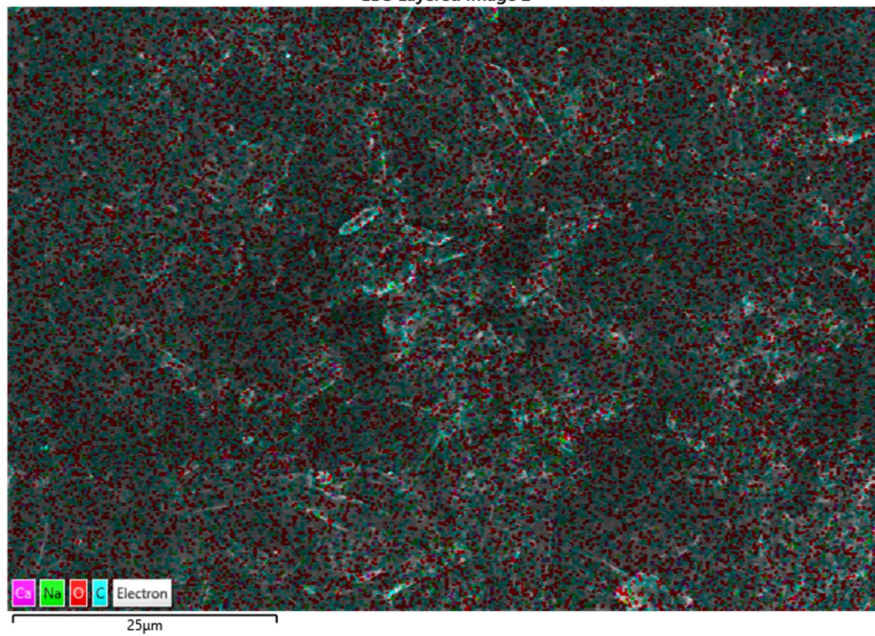


Element	Map Sum Spectrum Weight %	$\sigma$
C	50.8	0.2
O	46.8	0.2
Si	2.0	0.0
Na	0.2	0.0
Al	0.2	0.0

### Film Ag-Agarosa

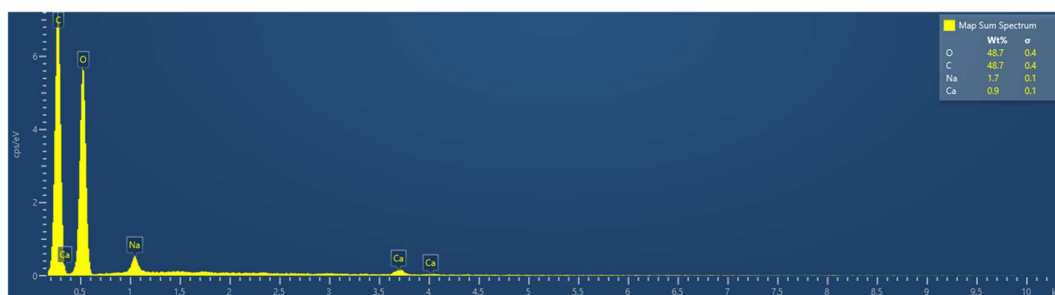


EDS Layered Image 2



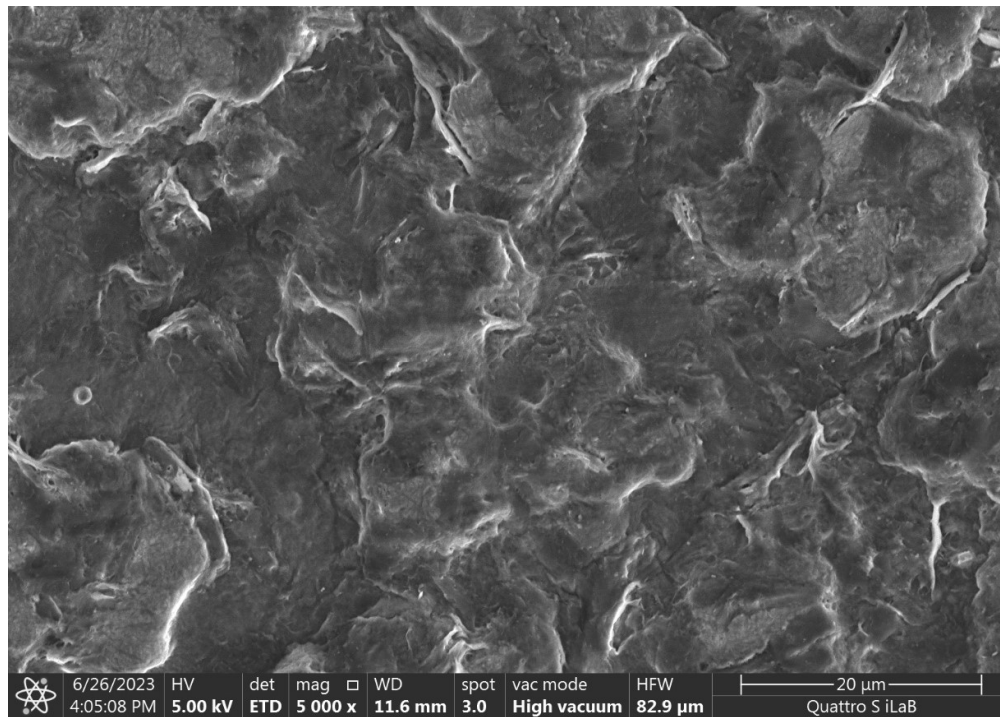
Budi saksono-87418

26/06/2023

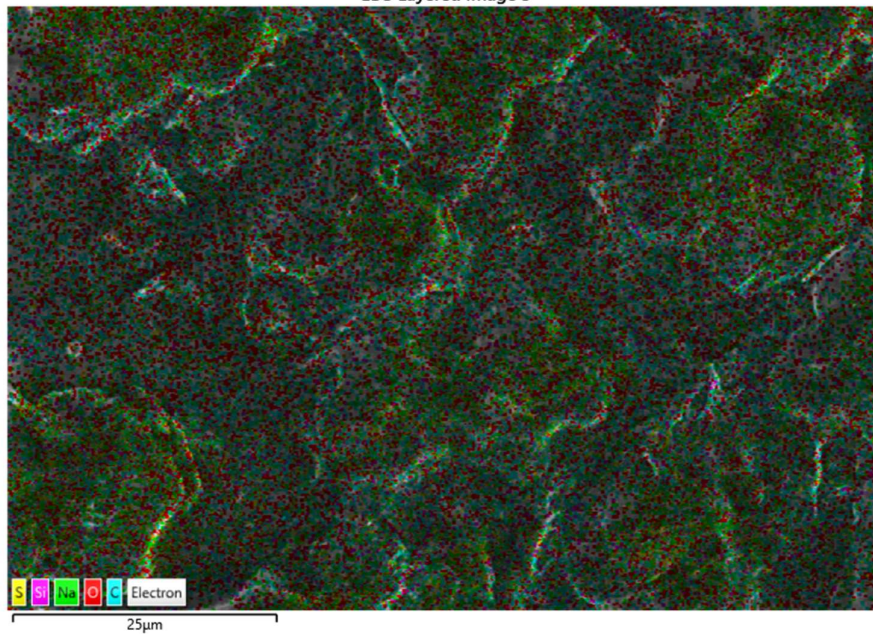


Element	Map Sum Spectrum Weight %	$\sigma$
O	48.7	0.4
C	48.7	0.4
Na	1.7	0.1
Ca	0.9	0.1

### Film Cu-Agarosa



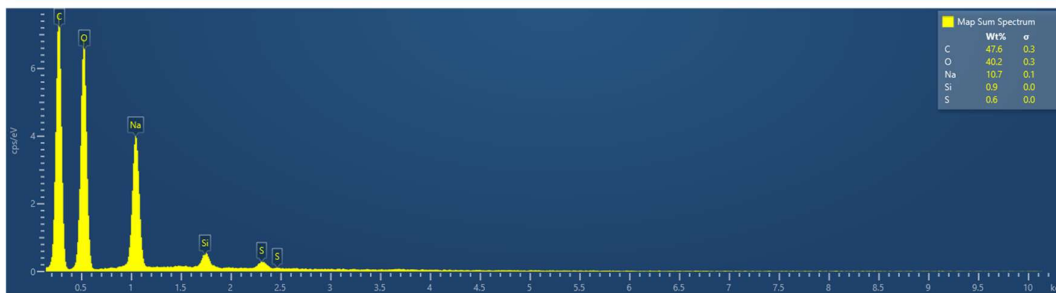
EDS Layered Image 3





Budi saksono-87418

26/06/2023

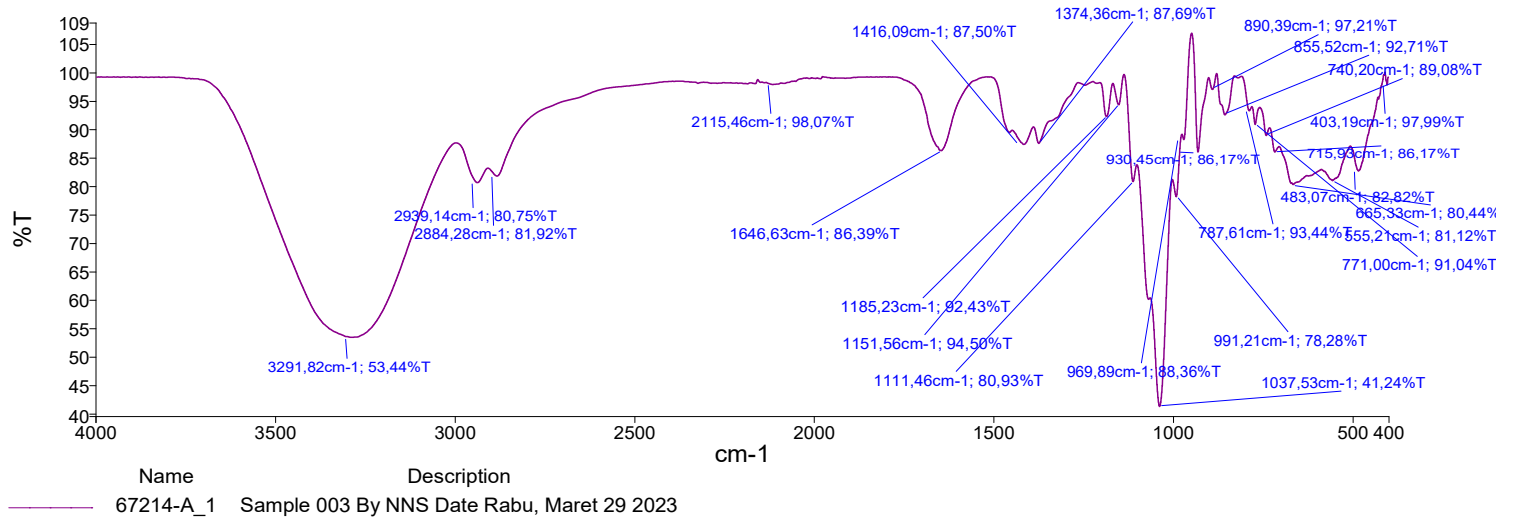


Element	Map Sum Spectrum Weight %	σ
C	47.6	0.3
O	40.2	0.3
Na	10.7	0.1
Si	0.9	0.0
S	0.6	0.0

7. Uji FTIR

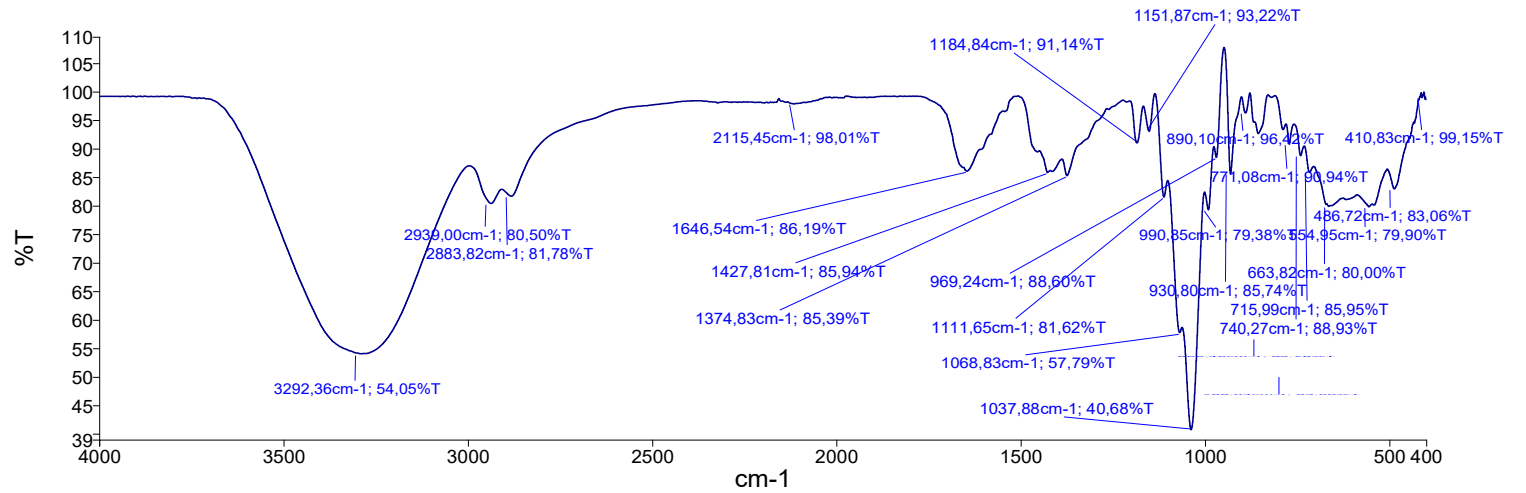
Agarosa

Peak Number	X (cm-1)	Y (%T)
1	3291,82	53,44
2	2939,14	80,75
3	2884,28	81,92
4	2115,46	98,07
5	1646,63	86,39
6	1416,09	87,50
7	1374,36	87,69
8	1185,23	92,43
9	1151,56	94,50
10	1111,46	80,93
11	1037,53	41,24
12	991,21	78,28
13	969,89	88,36
14	930,45	86,17
15	890,39	97,21
16	855,52	92,71
17	787,61	93,44
18	771,00	91,04
19	740,20	89,08
20	715,93	86,17
21	665,33	80,44
22	555,21	81,12
23	483,07	82,82
24	403,19	97,99



Ag-agarosa

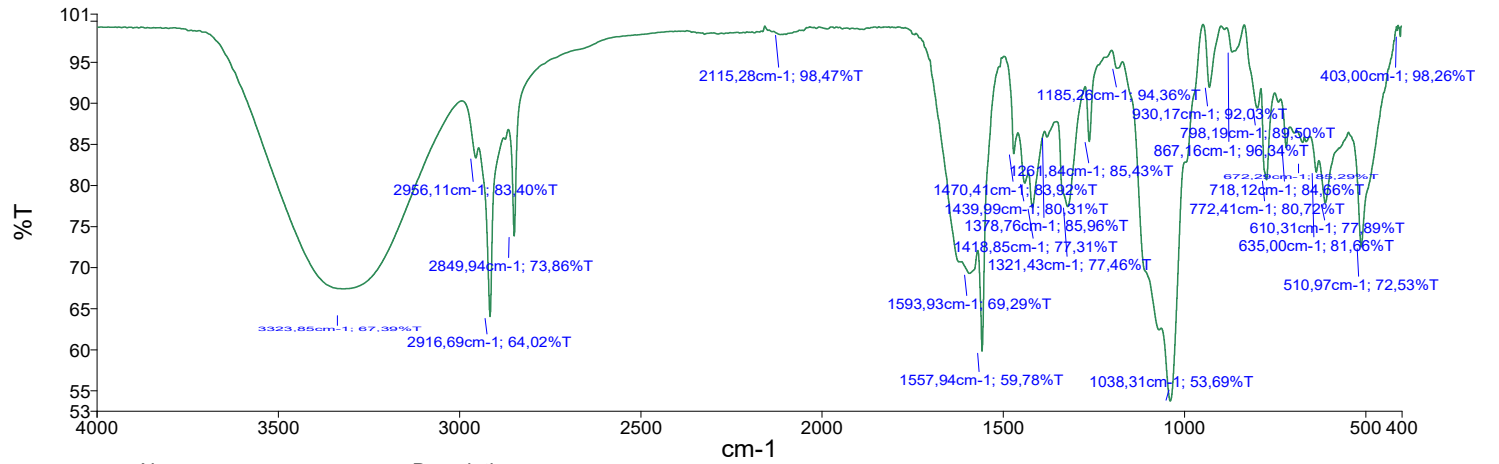
Peak Number	X (cm-1)	Y (%T)
1	3292,36	54,05
2	2939,00	80,50
3	2883,82	81,78
4	2115,45	98,01
5	1646,54	86,19
6	1427,81	85,94
7	1374,83	85,39
8	1184,84	91,14
9	1151,87	93,22
10	1111,65	81,62
11	1068,83	57,79
12	1037,88	40,68
13	990,85	79,38
14	969,24	88,60
15	930,80	85,74
16	890,10	96,42
17	855,45	92,78
18	788,04	93,50
19	771,08	90,94
20	740,27	88,93
21	715,99	85,95
22	663,82	80,00
23	554,95	79,90
24	486,72	83,06
25	410,83	99,15



Name: 67214-B\_1  
 Description: Sample 004 By NNS Date Rabu, Maret 29 2023

Cu-agarosa

Peak Number	X (cm-1)	Y (%T)
1	3323,85	67,39
2	2956,11	83,40
3	2916,69	64,02
4	2849,94	73,86
5	2115,28	98,47
6	1593,93	69,29
7	1557,94	59,78
8	1470,41	83,92
9	1439,99	80,31
10	1418,85	77,31
11	1378,76	85,96
12	1321,43	77,46
13	1261,84	85,43
14	1185,26	94,36
15	1038,31	53,69
16	930,17	92,03
17	867,16	96,34
18	798,19	89,50
19	772,41	80,72
20	718,12	84,66
21	672,29	85,29
22	635,00	81,66
23	610,31	77,89
24	510,97	72,53
25	403,00	98,26



Name: 67214-C\_1  
 Description: Sample 005 By NNS Date Rabu, Maret 29 2023

## H. Uji TPC Aplikasi Kemasan Antibakteri



**KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN  
UNIVERSITAS KHAIRUN  
FAKULTAS KEGURUAN DAN ILMU PENDIDIKAN  
LABORATORIUM BIOLOGI**

Jl. Bandara Sultan Babullah Kota Ternate Utara, Kota k Pos 53 Ternate 97 728, Telepon : 092131110905  
Laman : <http://labbio.unkhair.ac.id> ; Email : [labbio@unkhair.ac.id](mailto:labbio@unkhair.ac.id)

### LAPORAN HASIL UJI

Pengirim Sampel : Rahmania  
Instansi : Universitas Hasanudin  
Alamat : Sabia Kel. Sangaji, Ternate Utara  
Jenis Sampel : Ikan Fufu Kemasan  
Jumlah : 3 Kemasan  
Tanggal Masuk : 24 Januari 2023  
Tanggal Pengujian : 24 – 26 Januari 2023

No	Kode Lab	Kode Sampel	Parameter	Metode	Hasil Analisis	Satuan
1	B-001	K	Total Bakteri	TPC (Pour Plate) SNI 2897:2008	$3,4 \times 10^8$	CFU
2	B-002	Ag	Total Bakteri	TPC (Pour Plate) SNI 2897:2008	$1,9 \times 10^6$	CFU
3	B-003	Cu	Total Bakteri	TPC (Pour Plate) SNI 2897:2008	$2,7 \times 10^7$	CFU



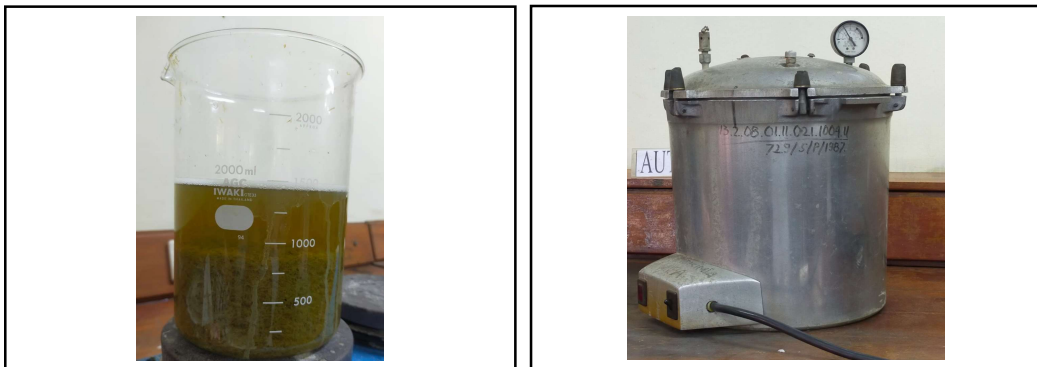
Kepala Laboratorium Biologi

Nurmaya Papuangan, S.Pd., M. Si  
NIP. 197912292003122001

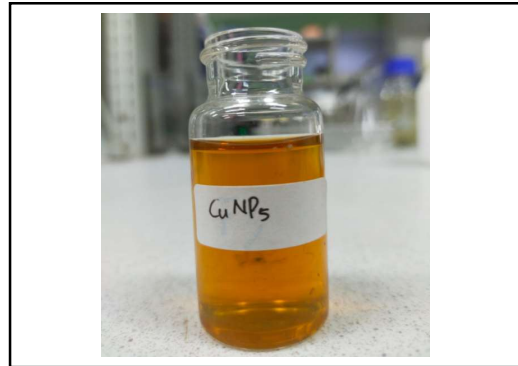
**Lampiran 3. Dokumentasi****PREPARASI SAMPEL****UJI KOMPONEN KIMIA**



### UJI KOMPONEN KIMIA



### ISOLASI AGAROSA



**SINTESIS NANOPARTIKEL LOGAM**

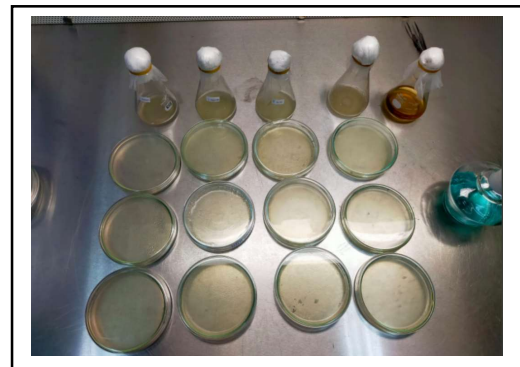
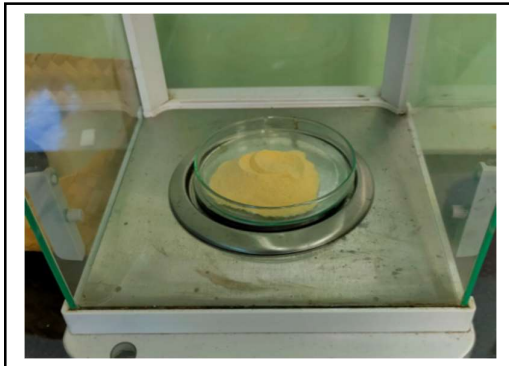


**PEMBUATAN FILM NANOKOMPOSIT**





**PEMBUATAN FILM NANOKOMPOSIT**



**UJI ANTIBAKTERI**



**UJI KELARUTAN**



**UJI BIODEGRADABILITAS**



**UJI APLIKASI KEMASAN ANTIBAKTERI**