

## V. KESIMPULAN DAN SARAN

### 5.1. Kesimpulan

1. Penambahan bahan aktif ekstrak kubis merah dan tepung cangkang telur ayam pada *smart edible packaging* memberikan pengaruh nyata terhadap aktivitas antioksidan, laju transmisi uap air/WVTR, kuat tarik, dan persen pemanjangan.
2. Penambahan tepung cangkang telur ayam tidak memberikan pengaruh terhadap kadar total fenol dan total antosianin *smart edible packaging*.
3. Penambahan bahan aktif ekstrak kubis merah dan tepung cangkang telur ayam pada *smart edible packaging* meningkatkan aktivitas antioksidan sebesar 15,62-60,91 %RSA, WVTR sebesar 172,7656-198,9684 g/m<sup>2</sup>/24 jam, kuat tarik sebesar 2,8775-12,5625 N/mm<sup>2</sup>, dan persen pemanjangan sebesar 1,44-8,97%.
4. Penambahan bahan aktif ekstrak kubis merah dan tepung cangkang telur ayam pada *smart edible packaging* menghasilkan total fenol sebesar 398,2273-560,9545 mg GAE/100 g sampel dan total antosianin sebesar 14,3276-20,6899 mg cy-3-glu-eq/100 g sampel.
5. Terjadi perubahan warna *smart edible packaging* (ungu kebiruan menjadi ungu muda), warna daging ayam (putih menjadi cokelat), aroma daging ayam (segar menjadi tidak sedap), dan peningkatan pH daging ayam (5,91-6,95) selama 3 hari penyimpanan.

### 5.2. Saran

Perlu dilakukan penelitian lebih lanjut mengenai bahan tambahan yang sesuai untuk meningkatkan ketahanan *smart edible packaging* terhadap uap air sehingga *smart edible packaging* diharapkan dapat diaplikasikan pada produk pangan dengan kadar air yang tinggi.

## DAFTAR PUSTAKA

- Abedi-Firoozjah, R., Yousefi, S., Heydari, M., Seyedfatehi, F., Jafarzadeh, S., Mohammadi, R., Rouhi, M., & Garavand, F. (2022). Application of Red Cabbage Anthocyanins as pH-Sensitive Pigments in Smart Food Packaging and Sensors. *Polymers*, 14(1629), 1-21.
- Ahmed, J. K., Amer, Z. J. A., & Al-Bahate, M. J. M. (2015). Effect of Chlorophyll and Anthocyanin on The Secondary Bonds of Poly Vinyl Chloride (PVC). *International Journal of Materials Science and Applications*, 4(2-1), 21-29.
- Aidah, S. N. (2020). *Ensiklopedia Kubis Deskripsi, Filosofi, Manfaat, Budidaya, dan Peluang Bisnisnya*. Penerbit KBM Indonesia.
- Aksun, E. T. (2016). Using Smart Packaging in Fish and Fish Based Product. *Turkish Journal of Maritime and Marine Sciences*, 2(1), 8-18.
- Albrecht, A., Herbert, U., Miskel, D., Heinemann, C., Braun, C., Dohlen, S., Zeits, J. O., Eder, K., Saremi, B., & Kreyenschmidt, J. (2017). Effect of Methionine Supplementation in Chicken Feed on The Quality and Shelf Life of Fresh Poultry Meat. *Poultry Science*, 96(8), 2853-2861.
- Ardin, L., Karimuna, L., & Pagala, M. A. (2019). Formulasi Tepung Cangkang Telur dan Tepung Beras Merah Terhadap Nilai Kalsium dan Organoleptik Kue Karasi. *Jurnal Sains dan Teknologi Pangan*, 4(1), 1892-1904.
- Ashour, E. A., Farsi, R. M., Alaidaroos, B. A., Abdel-Moneim, A. E., El-Saadony, M. T., Osman, A. O., Sayed-Ahmed, E. T. A., Albaqami, N. M., Shafi, M. E., Taha, A. E., & El-Hack, M. E. (2021). Impacts of Dietary Supplementation of Pyocyanin Powder on Growth Performance, Carcase Traits, Blood Chemistry, Meat Quality and Gut Microbial Activity of Broilers. *Italian Journal of Animal Science*, 20(1), 1357-1372.
- Astadi, I. R., Astuti, M., Santoso, U., & Nugraheni, P. S. (2009). In Vitro Antioxidant Activity of Anthocyanins of Black Soybean Seed Coat in Human Low Density Lipoprotein (LDL). *Food Chemistry*, 112, 659-663.
- Ávila, S., Zalamanski, S., Tanikawa, L. M., Kruger, C. C. H., & Ferreira, S. M. R. (2022). Influence of Cooking Methods on In Vitro Bioaccessibility of Phenolics, Flavonoids, and Antioxidant Activity of Red Cabbage. *Plant Foods for Human Nutrition*, 1-14.

- Aydin, S. (2020). Total Phenolic Content, Antioxidant, Antibacterial and Antifungal Activities, Ft-Ir Analyses of *Brassica oleracea* L. var. *acephala* and *Ornithogalum umbellatum* L. *Genetika*, 52(1), 229-244.
- Bardford, K. J., Dahal, P., Asbrouck, J. V., Kunusoth, K., Bello, P., Thompson, J., & Wu, F. (2018). The dry chain: Reducing Postharvest Losses and Improving Food Safety in Humid Climates. *Trends in Food Science & Technology*, 71, 84-93.
- Bosco, A. D., Mancicelli, A. C., Vaudo, G., Cavallo, M., Castelline, C., Mattioli, S. (2022). Indexing of Fatty Acids in Poultry Meat for Its Characterization in Healthy Human Nutrition: A Comprehensive Application of the Scientific Literature and New Proposals. *Nutrients*, 14, 1-18.
- Boyaci, D., Kavur, P. B., Gulec, S., & Yemencioğlu, A. (2021). Physicochemical and Active Properties of Gelatine-Based Composite Gels Loaded with Lysozyme and Green Tea Polyphenols. *Food Technology & Biotechnology*, 59(3), 337-348.
- Caramês, E. T. S., Alamar, P. D., & Pallone, J. A. L. (2020). Bioactive Compounds and Antioxidant Capacity in Freeze-Dried Red Cabbage by FT-NIR and MIR Spectroscopy and Chemometric Tools. *Food Analytical Methods*, 13(1), 78-85.
- Channa, I. A., Ashfaq, J., Siddiqui, M. A., Chandio, A. D., Shar, M. A., & Alhazaa, A. (2022). Multi-Shaded Edible Films Based on Gelatin and Starch for the Packaging Applications. *Polymers*, 14, 1-16.
- Chen, Y., Qiao, Y., Xiao, Y., Chen, H., Zhao, L., Huang, M., & Zhou, G. (2016). Differences in Physicochemical and Nutritional Properties of Breast and Thigh Meat from Crossbred Chickens, Commercial Broilers, and Spent Hens. *Asian-Australasian Journal of Animal Sciences*, 29(6), 855-864.
- Cheng, M., Yan, X., Cui, Y., Han, M., Wang, Y., Wang, J., Zhang, R., & Wang, X. (2022). Characterization and Release Kinetics Study of Active Packaging Films Based on Modified Starch and Red Cabbage Anthocyanin Extract. *Polymers*, 14, 1-14.
- Chisenga, S. M., Workneh, T. S., Bultosa, G., & Alimi, B. A. (2019). Progress in Research and Applications of Cassava Flour and Starch: A Review. *Journal of Food Science and Technology*, 56(6), 2799–2813.
- Cruz, A. B., Pitz, H. S., Veber, B., Bini, L. A., Maraschin, M., & Zeni, A. L. B. (2016). Assessment of Bioactive Metabolites and

- Hypolipidemic Effect of Polyphenolic-Rich Red Cabbage Extract. *Pharmaceutical Biology*, 54(12), 3033-3039.
- Darmajana, D. A., Afifah, N., Solihah, E., & Indriyanti, N. (2017). Pengaruh Pelapis Dapat Dimakan dari Karagenan terhadap Mutu Melon Potong dalam Penyimpanan Dingin. *AGRITECH*, 37(3), 280-287.
- Dordevic, S., Dordevic, D., Sedlacek, P., Kalina, M., Tesikova, K., Antonic, B., Tremlova, B., Treml, J., Nejezchlebova, M., Vapenka, L., Rajchl, A., Bulakova, M. (2021). Incorporation of Natural Blueberry, Red Grapes and Parsley Extract By-Products into the Production of Chitosan Edible Films. *Polymers*, 13, 1-21.
- Ekrami, M., Roshani-Dehlaghi, N., Ekrami, A., Shakouri, M., & Emam-Djomeh, Z. (2022). pH-responsive Color Indicator of Saffron (*Crocus sativus* L.) Anthocyanin-Activated Salep Mucilage Edible Film for Real-Time Monitoring of Fish Fillet Freshness. *Chemistry*, 4, 1360-1381.
- Erken, O., & Kaya, S. (2017). Free Radical Scavenging Activity, Phenolic Contents and Flavonoids of Four Cruciferous Vegetables: Effects of Extraction. *Fresenius Environmental Bulletin*, 26(7), 4383-4389.
- Erturk, A. G., Erturk, O., Ayvaz, M. C., & Erturk, E. Y. (2018). Screening of Phytochemical, Antimicrobial and Antioxidant Activities in Extracts of Some Fruits and Vegetables Consumed in Turkey. *Celal Bayar University Journal of Science*, 14(1), 81-92.
- Fang, S., Guan, Z., Su, C., Zhang, W., Zhu, J., Zheng, Y., Li, H., Zhao, P., & Liu, X. (2022). Accurate Fish-Freshness Prediction Label Based on Red Cabbage Anthocyanins. *Food Control*, 138, 1-10.
- Faridah, D. N., & Thonthowi, A. (2020). Karakterisasi Fisik Pati Tapioka Modifikasi Gabungan Hidroksipropilasi dengan Fosfat-Ikat Silang. *Jurnal Mutu Pangan*, 7(1), 30-37.
- Fera, M., & Nurkholid. (2018). Kualitas Fisik Edible Film yang Diproduksi dari Kombinasi Gelatin Kulit Domba dan Agar (*Gracilaria sp*). *Journal of Food and Life Science*, 2(1), 45-56.
- Fermatt-Flores, G. E., Aguiló-Aguayo, I., Marcos, B., Camargo-Olivas, B. A., Sánchez-Vega, R., Soto-Caballero, M. C., Salas-Salazar, N. A., Flores-Córdova, M. A., Rodríguez-Roque, M. J. (2022). Milk Protein-Based Edible Films: Influence on

- Mechanical, Hydrodynamic, Optical and Antioxidant Properties. *Coatings*, 12(196), 1-11.
- Freitas, P. A. V., Silva, R. R. A., Oliveira, T. V., Soares, R. R. A., Junior, N. S., Moraes, A. R. F., Pires A. C. S., & Soares, N. F. F. (2020). Development and Characterization of Intelligent Cellulose Acetate-based Films using Red Cabbage Extract for Visual Detection of Volatile Bases. *LWT – Food Science and Technology*, 132, 1-10.
- Gasti, T. Dixit, S., D'souza, O., Hiremani, V. D., Vootla, S. K., Masti, S. P., Chougale, R. B., & Malabadi, R. B. (2021). Smart Biodegradable Films Based on Chitosan/Methylcellulose Containing *Phyllanthus reticulatus* Anthocyanin for Monitoring The Freshness of Fish Fillet. *International Journal of Biological Macromolecules*, 187, 451-461.
- Gela, D. T. (2016). Karakteristik Edible Film dari Gelatin Kulit Kuda (*Equus caballus*) Serta Aplikasinya Untuk Kemasan Makanan. *Skripsi*. Fakultas Sains dan Teknologi, Universitas Islam Negeri Alauddin, Makassar.
- Ghanbarzadeh, B., Almasi, H., & Entezami, A. A. (2010). Physical Properties of Edible Modified Starch/Carboxymethyl Cellulose Films. *Innovative Food Science and Emerging Technologies*, 11, 697-702.
- Ghareaghajlou, N., Hallaj-Nezhadi, S., & Ghasempour, Z. (2021). Red Cabbage Anthocyanins: Stability, Extraction, Biological Activities and Applications in Food Systems. *Food Chemistry*, 365. DOI: <https://doi.org/10.1016/j.foodchem.2021.130482>
- Ghoshal, G. (2018). Recent Trends in Active, Smart, and Intelligent Packaging for Food Products. *Food Packaging and Preservation*, 343-374.
- Guntarti, A., Yuningtyas, R., Susanti, H., & Zainab. (2021). Penetapan Total Flavonoid dan Aktivitas Antioksidan Ekstrak Etanol Kubis Ungu (*Brassica oleracea* L. Var. *Capitata F. Rubra*) dan Kubis Putih (*Brassica oleracea* L. Var. *Capitata F. Alba*) dengan Metode DPPH (1,1-Difenil-2-Pikrilhidrazil). *Jurnal Farmasi Sains dan Praktis*, 7(2), 135-143.
- Hanani, N. Z. A. (2016). Gelatin. *The Encyclopedia of Food and Health*, 3, 191–195.
- Hendra, A. A., Utomo, A. r., & Setijawati, E. (2015). Kajian Karakteristik Edible Film dari Tapioka dan Gelatin dengan Perlakuan Penambahan Gliserol. *Jurnal Teknologi Pangan dan Gizi*, 14(2), 95-100.

- Ifadah, R. A., Wiratara, P. R. W., & Afgani, C. A. (2021). Ulasan Ilmiah: Antosianin dan Manfaatnya untuk Kesehatan. *Jurnal Teknologi Pengolahan Pertanian*, 3(2), 11-21.
- Japanese Industrial Standard* (JIS). (1975). *Japanese Standards Association*, 2, 1707.
- Jiang, B., Li, S., Wu, Y., Song, J., Chen, S., Li, X., & Sun, H. (2018). Preparation and Characterization of Natural Corn Starch-Based Composite Films Reinforced by Eggshell Powder. *CYTA – Journal of Food*, 16(1), 1045-1054.
- Juliaستuti, H., Yuslianti, E. R., Rakhamat, I. I., Handayani, D. R., Prayoga, A. M., Ferdianti, F. N., Prastia, H. S., Dara, R. J., Syarifah, S., & Rizkani, E. N. (2021). *Sayuran dan Buah Berwarna Merah, Antioksidan dan Penangkal Radikal Bebas*. Deepublish.
- Kadzińska, J., Janowicz, M., Kalisz, S., Bryś, J., & Lenard, A. (2018). An Overview of Fruit and Vegetable Edible Packaging Materials. *Packaging Technology and Science*, 32(10), 483-495.
- Kementerian Kesehatan RI. (2018). *Tabel Komposisi Pangan Indonesia*. Kementerian Keseharian RI.
- Kim, D., Lee, S., Lee, K., Baek, S., & Seo, J. (2017). Development of a pH Indicator Composed of High Moistureabsorbing Materials For Real-Time Monitoring of Chicken Breast Freshness. *Food Science and Biotechnology*, 26(1), 37-42.
- Koss-Mikołajczyk, I., Kusznierewicz, B., Wiczkowski, W., Płatosz, N., & Bartoszek, A. (2019). Phytochemical Composition and Biological Activities of Differently Pigmented Cabbage (*Brassica oleracea* var. *capitata*) and Cauliflower (*Brassica oleracea* var. *botrytis*) Varieties. *Journal of the Science of Food and Agriculture*, 99(12), 5499-5507.
- Krishnan, K. R., Babuskin, S., Babu, P. A. S., Sasikala, M., Sabina, K., Archana, G., Sivarajan, M., & Sukumar, M. (2014). Antimicrobial and Antioxidant Effects of Spice Extracts on The Shelf Life Extension of Raw Chicken Meat. *International Journal of Food Microbiology*, 171, 32–40.
- Kumari, N., Bangar, S. P., Petru, M., Ilyas, R. A., Singh, A., & Kumar, P. (2021). Development and Characterization of Fenugreek Protein-Based Edible Film. *Foods*, 10, 1-13.
- Lee, J., Durst, R., & Wrolstad, R. (2005). Determination of Total Monomeric Anthocyanin Pigment Content of Fruit Juices, Beverages, Natural Colorants, and Wines by The pH

- Differential Method: Collaborative Study. *Journal of AOAC International*, 88(5), 1269-1278.
- Lesti, A., Cristy, G., Aguastina, S., Nata, I. F. (2020). Synthesis and Characterization of Starch-Based Functional Edible Film. *Konversi*, 9(2), 92-97.
- Luhurningtyas, F. P., Susilo, J., Yuswantina, R., Widhihastuti, E., & Ardiyansah, F. W. (2021). Aktivitas Imunomodulator dan Kandungan Fenol Ekstrak Terpurifikasi Rimpang Jahe Merah (*Zingiber officinale* Rosc. Var.Rubrum). *Indonesian Journal of Pharmacy and Natural Product*, 4(1), 51-59.
- Lung, J. K. S., & Destiani, P. (2017). Uji Aktivitas Antioksidan Vitamin A, C, E dengan Metode DPPH. *Farmaka*, 15(1), 53-62.
- Lv, L. C., Huang, Q. Y., Ding, W., Xiao, X. H., Zhang, H. Y., & Xiong, L. X. (2019). Fish Gelatin: The Novel Potential Applications. *Journal of Functional Foods*, 63, 1-14.
- Maan, A. A., Ahmed, Z. F. R., Khan, M. K. I., Riaz, A., & Nazir, A. (2021). *Aloe vera* Gel, An Excellent Base Material for Edible Films and Coatings. *Trends in Food Science & Technology*, 116, 329-341.
- Mahdi, A., Al-Ansi, W., Noman, A., & Al-Farga, A. (2016). Gelatin: Mini-Review. *European Academic Research*, 4(6), 5154-5163.
- Mamonto, O. I. C., Lengkey, L. C. C. E., & Wenur, F. (2020). Analisis Penggunaan Beberapa Jenis Kemasan Plastik terhadap Umur Simpan Sayur Selada (*Lactuca sativa* L) selama Penyimpanan Dingin. *Cocos*, 4(4). DOI: <https://doi.org/10.35791/cocos.v4i4.29974>
- Manab, A., Sawitri, M. E., & Awwaly, K. U. A. (2017). *Edible Film Protein Whey (Penambahan Lisozim Telur dan Aplikasi di Keju)*. Universitas Brawijaya Press.
- Marin, R. F., Fernandes, S. C. M., Sánchez, M. A. A., & Labidi, J. (2022). Halochromic and Antioxidant Capacity of Smart Films of Chitosan/Chitin Nanocrystals with Curcuma Oil and Anthocyanins. *Food Hydrocolloids*, 123, 1-10.
- Mehran, M., Masoum, S., & Memarzadeh, M. (2020). Improvement of Thermal Stability and Antioxidant Activity of Anthocyanins of *Echium amoenum* Petal Using Maltodextrin/Modified Starch Combination as Wall Material. *International Journal of Biological Macromolecules*, 148, 768-776.
- Mei, L. X., Nafchi, A. M., Ghsemipour, F., Easa, A. M. Jafarzadeh, S., & Al-Hassan, A. A. (2020). Characterization of pH

- Sensitive Sago Starch Films Enriched with Anthocyanin-Rich Torch Ginger Extract. *International Journal of Biological Macromolecules*, 164, 4603-4612.
- Moghadam, M., Salami, M., Mohammadian, M., & Emam-Djomeh, Z. (2021). Development and Characterization of pH-Sensitive and Antioxidant Edible Films Based on Mung Bean Protein Enriched with *Echium amoenum* Anthocyanins. *Journal of Food Measurement and Characterization*, 15(4), 2984-2994.
- Moghadam, M., Salami, M., Mohammadian, M., Khodadadi, M., & Emam-Djomeh, Z. (2020). Development of Antioxidant Edible Films Based on Mung Bean Protein Enriched with Pomegranate Peel. *Food Hydrocolloids*, 104, 1-8.
- Mondol, S. S. (2016). Investigation of Material Properties of Woven Glass Fiber Reinforced Epoxy Composite, *Thesis*, Department of Mechanical Engineering, Heritage Institute of Technology, India.
- Muin, R., Anggraini, D., & Malau, F. (2017). Karakteristik Fisik dan Antimikroba Edible Film dari Tepung Tapioka dengan Penambahan Gliserol dan Kunyit Putih. *Jurnal Teknik Kimia*, 3(23), 191-198.
- Murador, D. C., Mercadante, A. Z., & Rosso, V. V. (2016). Cooking Techniques Improve The Levels of Bioactive Compounds and Antioxidant Activity in Kale and Red Cabbage. *Food Chemistry*, 196, 1101-1107.
- Mustafa, A. (2015). Analisis Proses Pembuatan Pati Ubi Kayu (Tapioka) Berbasis Neraca Massa. *AGROINTEK*, 9(2), 127-133.
- Nata, I., C. Irawan, M. Adawiyah, and S. Ariwibowo. (2020). Edible Film Cassava Starch/Eggshell Powder Composite Containing Antioxidant: Preparation and Characterization. In *IOP Conference Series: Earth and Environmental Science* (Vol. 524, No. 1, p. 012008). IOP Publishing.
- Nogueira, G. F., Fakhouri, F. M., Oliveira, R. A. (2018). (2018): Effect of Incorporation of Blackberry Particles on The Physicochemical Properties of Edible Films of Arrowroot Starch. *Drying Technology*, 1-10.
- Noshad, M., Behbahani, B. A., Jooyandeh, H., Rahmati-Joneidabad, M., Kaykha, M. E. H., & Sheikhjan, M. G. (2021). Utilization of *Plantago major* Seed Mucilage Containing Citrus Limon Essential Oil as An Edible Coating to Improve Shelf-Life of

- Buffalo Meat Under Refrigeration Conditions. *Food Science and Nutritons*, 9, 1625-1639.
- Nuansa, M. F., Agustini, T. W., & Susanto, E. (2017). Karakteristik dan Aktivitas Antioksidan Edible Film dari Refined Karaginan dengan Penambahan Minyak Atsiri. *J. Peng. & Biotek*, 6(1), 54-62.
- Nusa, M. I., Siregar, S. N., & Muzdalifah, L. (2017). Pembuatan Edible Film dari Pati Temu Hitam (*Curcuma aeruginosa Roxb.*) dengan Penambahan Gliserol. *AGRINTECH*, 1(1), 16-22.
- Ora, F. H. (2015). *Buku Ajar Struktur dan Komponen Telur*. Deepublish.
- Oroian, M., Leahu, A., Dutuc, A., & Dabija, A. (2017). Optimization of Total Monomeric Anthocyanin (TMA) and Total Phenolic Content (TPC) Extractions from Red Cabbage (*Brassica oleracea* var<sup>c</sup>apitata f. *rubra*): Response Surface Methodology versus Artificial Neural Network. *International Journal of Food Engineering*, 13(3), 1-11.
- Pereira, J. A., Dionísio, L., Patarata, L., & Matos, T. J. S. (2019). Multivariate nature of A Cooked Blood Sausage Spoilage Along Aerobic and Vacuum Package Storage. *Food Packaging and Shelf Life*, 20, 1-7.
- Petkoska, A. T., Daniloski, D., D'Cunha, N. M., Naumovski, N., & Broach, A. T. (2021). Edible Packaging: Sustainable Solution and Novel Trends in Food Packaging. *Food Research International*, 140. DOI: <https://doi.org/10.1016/j.foodres.2020.109981>
- Platzer, M., Kiese, S., Helfernel, T., Schweiggert-Weisz, U., & Eisner, P. (2021). How Does the Phenol Structure Influence the Results of the Folin-Ciocalteu Assay?. *Antioxidant*, 10(5), 1-13.
- Pramesti, H. A., Siadi, K., & Cahyono, E. (2015). Analisis Rasio Kadar Amilosa/Aamilopektin dalam Amilum dari Beberapa Jenis Umbi. *Indonesian Journal of Chemical Science*, 4(1), 27-30.
- Pratiwi, S. W., & Priyani, A. A. (2019). Pengaruh Pelarut dalam Berbagai pH Pada Penentuan Kadar Total Antosianin dari Ubi Jalar Ungu dengan Metode pH Diferensial Spektrofotometri. *EduChemia*, 4(1), 89-96.
- Prietto, L., Mirapalhete, T. C., Pinto, V. Z., Hoffmann, J. F., Vanier, N. L., Lim, L., Dias, A. R. G., & Zavareze. (2017). pH-

- sensitive Films Containing Anthocyanins Extracted from Black Bean Seed Coat and Red Cabbage. *LWT-Food Science and Technology*, 80, 492-500.
- Priska, M., Peni, N., Carevallo, L., & Ngapa, Y. D. (2018). Review: Antosianin dan Pemanfaatannya. *Cakra Kimia (Indonesian E-Journal of Applied Chemistry)*, 6(2), 79-97.
- Qiu, Y., Wang, Y., Yang, X., Zhao, Y., Chi, C., & Wang, B. (2019). Gelatin and Antioxidant Peptides from Gelatin Hydrolysate of Skipjack Tuna (*Katsuwonus pelamis*) Scales: Preparation, Identification and Activity Evaluation. *Marine drugs*, 17(565), 1-17.
- Rahmawati, W. A., & Nisa, F. C. (2015). Fortifikasi Kalsium Cangkang Telur pada Pembuatan Cookies Kajian Konsentrasi Tepung Cangkang Telur dan Baking Powder. *Jurnal Pangan dan Agroindustri*, 3(3), 1050-1061.
- Ramos, M., Valdés, A., Beltrán, A., & Garrigós, M. C. (2016). Gelatin-Based Films and Coatings for Food Packaging Applications. *Coatings*, 6(41), 1-20.
- Ribeiro, A. M., Estevinho, B. N., & Rocha, F. (2020). Preparation and Incorporation of Functional Ingredients in Edible Films and Coatings. *Food and Bioprocess Technology*, 14(2), 209-231.
- Riniati, Widya Budiningsih, D., & Sularasa, A. (2020). Penggunaan Indikator Kubis Ungu pada Analisis Asam Lemak Bebas dengan Metode Titrasi. *Indonesian Journal of Chemical Analysis*, 3(2), 56-64.
- Rizk, E. M., Azouz, A., & Hareedy, A. M. (2009). Evaluation of Red Cabbage Anthocyanin Pigments and Its Potential Uses as Antioxidant and Natural Food Colorants. *Arab Universities Journal of Agricultural Science*, 17(2), 361-372.
- Rosalyn. (2015). Karakteristik Edible Film dari Tapioka dengan Penambahan Gelatin. *Skripsi*. Jurusan Teknologi Pangan, Fakultas Teknologi Pertanian, Universitas Katolik Widya Mandala Surabaya, Surabaya.
- Said, N. S., & Sarbon, N. M. (2020). Response Surface Methodology (RSM) of Chicken Skin Gelatin Based Composite Films with Rice Starch and Curcumin Incorporation. *Polymer Testing*, 81. DOI: <https://doi.org/10.1016/j.polymertesting.2019.106161>
- Said, N. S., Howell, N. K., & Sarbon, N. M. (2021). A Review on Potential Use of Gelatin-based Film as Active and Smart Biodegradable Films for Food Packaging Application. *Food Reviews International*, 1-23.

- Saira, S., & Kamran, K. M. (2017). Stability of Anthocyanins from *Syzygium cumini* (Jamun) at Different Processing Condition. *Journal of Food Technology and Preservation*, 2(1), 1-5.
- Sai-Ut, S., Suthiluk, P., Tongdeesontorn, W., Rawdkuen, S., Kaewprachu, P., Karbowiak, T., Debeaufort, F., & Degraeve, P. (2021). Using Anthocyanin Extracts from Butterfly Pea as pH Indicator for Intelligent Gelatin Film and Methylcellulose Film. *Current Applied Science and Technology*, 21(4), 652-661.
- Sancaklı, A., Basaran, B., Arican, F., & Polat, O. (2021). Effects of Bovine Gelatin Viscosity on Gelatin-Based Edible Film Mechanical, Physical and Morphological Properties. *SN Applied Sciences*, 3(8), 1-11.
- Sanches, M. A. R., Camello-Silva, C., Carvalho, C. S., Mello, J. R., Barroso, N. G., Barros, E. L. S., Silva, P. P., & Pertuzatti, P. B. (2021). Active Packaging with Starch, Red Cabbage Extract and Sweet Whey: Characterization and Application in Meat. *LWT-Food Science and Technology*, 135, 1-10.
- Santos, L. G., Alves-Silva, G. F., & Martins, V. G. (2022). Active-intelligent and Biodegradable Sodium Alginate Films Loaded with *Clitoria ternatea* anthocyanin-rich Extract to Preserve and Monitor Food Freshness. *International Journal of Biological Macromolecules*, 220, 866-877.
- Santoso, B. (2020). *Edible Film: Teknologi dan Aplikasinya*. NoerFikri Offset.
- Sastyarina, Y., Ahmid, M. K., Soraya, A. F., Akmalia, N. N. N., Maulidya, S. S., & Utama, M. I. (2021). *Penerapan Teknologi Foil Sachet Sealer untuk Kemasan Jamu UMKM P4S Sari Bumi Herbal*. Pustaka Madani.
- Scartazzini, L., Tosati, J. V., Cortez, D. H. C., Rossi, M. J., Flores, S. H., Hubinger, M. D., Luccio, M. D., & Monteiro, A. R. (2019). Gelatin Edible Coatings with Mint Essential Oil (*Mentha Arvensis*): Film Characterization and Antifungal Properties. *Journal of Food Science and Technology*, 56(9), 4045-4056.
- Shahrezaee, M., Soleimanianzad, S., Soltanizadeh, N., & Alavijeh, S. A. (2018). Use of Aloe vera Gel Powder to Enhance the Shelf Life of Chicken Nugget During Refrigeration Storage. *LWT-Food Science and Technology*, 1(1), 1-30.
- Shankar, S., Jaiswal, L., & Rhim, J. W. (2016). Gelatin-Based Nanocomposite Films: Potential Use in Antimicrobial Active Packaging. *Antimicrobial Food Packaging*, 339-348.

- Sharma, N., Das, G. S., & Yun, K. (2020). Green Synthesis of Multipurpose Carbon Quantum Dots from Red Cabbage and Estimation of Their Antioxidant Potential and Bio-Labeling Activity. *Applied Microbiology and Biotechnology*, 104, 7187-7200.
- Siburian, W. Z., Rochima, E., Andriani, Y., & Praseptiangga, D. (2020). Fish Gelatin (Definition, Manufacture, Analysis of Quality Characteristics, and Application): A Review. *International Journal of Fisheries and Aquatic Studies*, 8(4), 90-95.
- Silva, F. A. P., Estévez, M., Ferreira, V. C. S., Silva, S. A., Lemos, L. T. M., Ida, E. I., Shimokomaki, M., & Madruga, M. S. (2018). Protein and Lipid Oxidations in Jerky Chicken and Consequences on Sensory Quality. *LWT - Food Science and Technology*, 97, 341-348.
- Silva, O. A., Pellá, M. G., Pellá, M. G., Caetano, J., Simões, M. R., Bittencourt, P. R. S., & Dragunski, D. C. (2019). Synthesis and Characterization of a Low Solubility Edible Film Based on Native Cassava Starch. *International Journal of Biological Macromolecules*, 128, 290-296.
- Sitanggang, A. B., Irsali, M. F., & Rawdkeun, S. (2020). Inkorporasi Oleat dan Ekstrak Antosianin Pada Film Gelatin Sebagai Indikator pH Untuk Kemasan Pintar. *Jurnal Teknologi dan Industri Pangan*, 31(1), 66-75.
- Sunarni, T., Pramono, S., & Asmah, R. (2007). Flavonoid Antioksidan Penangkap Radikal dari Daun Kepel (*Stelechocarpus burahol* (Bl.) Hook f. & Th.). *Majalah Farmasi Indonesia*, 18(3), 111-116.
- Tajalli, F., Saeedi, M., & Malekabadi, A. V. (2020). Anticancer and Antioxidant Effects of Red Cabbage on Three Cancerous Cell Lines and Comparison with a Normal Cell Line (HFF-3). *Journal of Genes and Cells*, 6(1), 12-20.
- Tamkutè, L., Vaicekauskaitè, R., Melero, B., Jaime, I., Rovira, J., & Venskutonis, P. R. (2021). Effects of Chokeberry Extract Isolated with Pressurized Ethanol from Defatted Pomace on Oxidative Stability, Quality and Sensory Characteristics of Pork Meat Products. *LWT - Food Science and Technology*, 150, 1-8.
- Teixeira, B. S., Gracia, R. H. L., Takinami, P. Y. I., & del Mastro, N. L. (2018). Comparison of Gamma Radiation Effects on Natural

- Corn and Potato Starches and Modified Cassava Starch. *Radiation Physics and Chemistry*, 142, 44-49.
- Upadhyay, R., Sehwag, S., & Singh, S. P. (2016). Antioxidant Activity and Polyphenol Content of *Brassica oleracea* Varieties. *International Journal of Vegetable Science*, 22(4), 353–363
- Vedove, T. M. A. R. D., Maniglia, B. C., & Tandini, C. C. (2020). Production of Sustainable Smart Packaging Based on Cassava Starch and Anthocyanin by An Extrusion Process. *Journal of Food Engineering*, 289. DOI: <https://doi.org/10.1016/j.jfoodeng.2020.110274>
- Vo, T., Dang, T., & Chen, B. (2019). Synthesis of Intelligent pH Indicative Films from Chitosan/Poly(Vinyl Alcohol)/Anthocyanin Extracted from Red Cabbage. *Polymers*, 11(7), 1-12.
- Vonnie, J. M., Rovina, K., Azhar, R. A., Huda, N., Erna, K. H., Felicia, W. X. L., Nur'Aqilah, M. N., & Halid, N. F. A. (2022). Development and Characterization of The Biodegradable Film Derived from Eggshell and Cornstarch. *Journal of Functional Biomaterials*, 13(67), 1-15.
- Wardana, A. A., & Widyaningsih, T. D. (2017). Development of Edible Films from Tapioca Starch and Agar, Enriched with Red Cabbage (*Brassica oleracea*) as A Sausage Deterioration Bio-indicator. In *IOP Conference Series: Earth and Environmental Science* (Vol. 109, No. 1, p. 012031). IOP Publishing.
- Wijayani, K. D., Darmanto, Y. S., & Susanto, E. (2021). Karakteristik Edible Film dari Gelatin Kulit Ikan yang Berbeda. *Jurnal Ilmu dan Teknologi Perikanan*, 3(1), 59-64.
- Wu, J., Liu, W., Yuan, L., Guan, W., Brennan, C. S., Zhang, Y., Zhang, J., & Wang, Z. (2017). The influence of Postharvest UV-C Treatment on Anthocyanin Biosynthesis in Fresh-Cut Red Cabbage. *Scientific Reports*, 7(1), 1-11.
- Yang, Z., Hemar, Y., Hilliou, I., Gilbert, E. P., McGillivray, D. J., Williams, M. A. K., & Chaieb, S. (2015). Non-Linear Behaviour of Gelatin Networks Reveals a Hierarchical Structure. *Biomacromolecules*, 17(2), 590-600.
- Yiğit, Ü., Turabi Yolaçaner, E., Hamzalioğlu, A., & Gökmen, V. (2022). Optimization of Microwave-Assisted Extraction of Anthocyanins in Red Cabbage by Response Surface

- Methodology. *Journal of Food Processing and Preservation*, 46, 1-13.
- Yonata, D., Aminah, S., & Hersoelistyorini, W. (2017). Kadar Kalsium dan Karakteristik Fisik Tepung Cangkang Telur Unggas dengan Perendaman Berbagai Pelarut. *Jurnal Pangan dan Gizi*, 7(2), 82-83.
- Yong, H., Liu, J., Qin, Y., Bai, R., Zhang, X., & Liu, J. (2019). Antioxidant and pH-Sensitive Films Developed by Incorporating Purple and Black Rice Extracts into Chitosan Matrix. *International Journal of Biological Macromolecules*, 137, 307-316.
- Youlanda, H. (2016). Ekstraksi dan Evaluasi Gelatin dari Kulit Sapi yang Telah Mengalami Proses Buang Bulu Menggunakan Hidrolisis Asam. *Skripsi*. Fakultas Kedokteran dan Ilmu Kesehatan, Program Studi Farmasi, Universitas Islam Negeri (UIN) Syarif Hidayatullah, Jakarta.
- Yousefi, H., Su, H., Imani, S. M., Alkhaldi, K., Filipe, C. D. M., & Didar, T. F. (2019). Intelligent Food Packaging: A Review of Smart Sensing Technologies for Monitoring Food Quality. *ACS Sensors*, 4, 808-821.
- Yun, D., Cai, H., Liu, Y., Xiao, L., Song, J., & Liu, J., (2019). Development of Active and Intelligent Films Based on Cassava Starch and Chinese Bayberry (*Myrica rubra* Sieb. Et Zucc.) Anthocyanins. *RSC Advances*, 9(53), 30905-30916.
- Zhai, X., Shi, J., Zou, X., Wang, S., Jiang, C., Zhang, J., Huang, X., Zhang, W., & Holmes, M. (2017). Novel Colorimetric Films Based on Starch/Polyvinyl Alcohol Incorporated with Roselle Anthocyanins for Fish Freshness Monitoring. *Food Hydrocolloids*, 69, 308-317.