

DAFTAR PUSTAKA

- A.V. Costa, B.C.B. Freitas, G.M. Rosa, L. Moraes, M.G. Morais, B.G. Mitchell, Operational and economic aspects of Spirulina-based biorefinery, *Bioresour. Technol.* 292 (2019), 121946. <https://doi.org/10.1016/j.biortech.2019.121946>
- Adjali, A., Clarot, I., Chen, Z., Marchioni, E., & Boudier, A. (2022). Physicochemical degradation of phycocyanin and means to improve its stability: A short review. *Journal of Pharmaceutical Analysis*, 12(3), 406–414. <https://doi.org/10.1016/j.jpha.2021.12.005>
- Ajandouz, E. H., Tchiakpe, L. S., Ore, F. D., Benajiba, A., & Puigserver, A. (2001). Effects of pH on Caramelization and Maillard Reaction Kinetics in Fructose-Lysine Model Systems. *Journal of Food Science*, 66(7), 926–931. <https://doi.org/10.1111/j.1365-2621.2001.tb08213.x>
- Akhtar, M.; Ding, R. Covalently cross-linked proteins & polysaccharides: Formation, characterisation and potential applications. *Curr. Opin. Colloid Interface Sci.* 2017, 28, 31–36.
- Alade, O. S., Mahmoud, M., Al Shehri, D. A., & Sultan, A. S. (2021). Rapid determination of emulsion stability using turbidity measurement incorporating artificial neural network (ANN): Experimental validation using video/optical microscopy and kinetic modeling. *ACS omega*, 6(8), 5910-5920.
- Alexander, P., Brown, C., Dias, C., Moran, D., & Rounsevell, M. D. A. (2019). Sustainable proteins production. *Proteins: Sustainable Source, Processing and Applications*. <https://doi.org/10.1016/b978-0-12-816695-6.00001-5>
- Almoselhy, R. I. (2020). Applications of differential scanning calorimetry (DSC) in oils and fats research. a review. *American Research Journal of Agriculture*.
- Amine, C., Dreher, J., Helgason, T., & Tadros, T. (2014). Investigation of emulsifying properties and emulsion stability of plant and milk proteins using interfacial tension and interfacial elasticity. *Food Hydrocolloids*, 39, 180-186.
- AOAC (1990). By Authority Of THE UNITED STATES OF AMERICA Legally Binding Document.
- Astuti, W. M., Dewi, E. N., & Kurniasih, R. A. (2019). Pengaruh perbedaan jenis pelarut dan suhu pemanasan selama ekstraksi terhadap stabilitas mikrokapsul fikosianin dari *Spirulina platensis*. *Jurnal Ilmu dan Teknologi Perikanan*, 1(1), 7-14.
- Asyhari, M. H., Palupi, N. S., & Faridah, N. (2018). Karakteristik kimia konjugat isolat protein kedelai-laktosa yang berpotensi dalam penurunan alergenitas. *Journal of Food Technology & Industry/Jurnal Teknologi & Industri Pangan*, 29(1).
- A'yun, Q., Demicheli, P., De Neve, L., Wu, J., Balcaen, M., Setiowati, A. D., ... & Van der Meer, P. (2020). Dry heat induced whey protein–lactose conjugates

- largely improve the heat stability of O/W emulsions. *International Dairy Journal*, 108, 104736.
- Bai, L., Huan, S., Rojas, O. J., & McClements, D. J. (2021). Recent innovations in emulsion science and technology for food applications. *Journal of Agricultural and Food Chemistry*, 69(32), 8944-8963.
- Bealer, E. J., Onissema-Karimu, S., Rivera-Galletti, A., Francis, M., Wilkowski, J., Salas-de La Cruz, D., & Hu, X. (2020). Protein–Polysaccharide Composite Materials: Fabrication and Applications. *Polymers*, 12(2), 464. <https://doi.org/10.3390/polym12020464>
- Becker, E. W. (2007). Micro-algae as a source of protein. *Biotechnology Advances*, 25: 207–210.
- Benelhadj, S., Gharsallaoui, A., Degraeve, P., Attia, H., & Ghorbel, D. (2016). Effect of pH on the functional properties of *Arthrospira* (*Spirulina*) *platensis* protein isolate. *Food Chemistry*, 194, 1056–1063. <https://doi.org/10.1016/j.foodchem.2015.08.133>
- Bernaerts, T.M.M., Panozzo, A., Doumen, V., Foubert, I., Gheysen, L., Goiris, K., Moldenaers, P., Hendrickx, M.E., and van Loey, A.M. 2017. “Microalgal biomass as a (multi)functional ingredient in food products: Rheological properties of microalgal suspensions as affected by mechanical and thermal processing.” *Algal Research* 25: 452–463 <https://doi.org/10.1016/j.algal.2017.05.014>
- Bertrand, E., El Boustany, P., Faulds, C., & Berdagué, J. L. (2018). The Maillard reaction in food: an introduction. *Reference module in food science*, np.
- Bertsch, P., Böcker, L., Mathys, A., & Fischer, P. (2021). Proteins from microalgae for the stabilization of fluid interfaces, emulsions, and foams. *Trends in Food Science & Technology*, 108, 326–342. <https://doi.org/10.1016/j.tifs.2020.12.014>
- Bleakley, S., and Hayes, M. 2017. “Algal proteins: Extraction, application, and challenges concerning production.” *Foods* 6 (5): 1–34 <https://doi.org/10.3390/foods6050033>
- Bocker., L., P. Bertsch, D. Wenner, S. Teixeira, J. Bergfreund, S. Eder, P. Fischer, A. Mathys, Effect of *Arthrospira platensis* microalgae protein purification on emulsification mechanism and efficiency, *J. Colloid Interface Sci.* 584 (2021) 344–353, <https://doi.org/10.1016/j.jcis.2020.09.067>.
- Borowitzka, M.A. 1995. Microalgae as sources of pharmaceuticals and other biologically active compounds. Kluwer Academic Publishers. v.7.
- Braga, A. R. C., Nunes, M. C., & Raymundo, A. (2023). The Experimental Development of Emulsions Enriched and Stabilized by Recovering Matter from *Spirulina* Biomass: Valorization of Residue into a Sustainable Protein Source. *Molecules*, 28(17), 6179. <https://doi.org/10.3390/molecules28176179>
- Candraningrum, R. G. S., Setiowati, A. D., & Hidayat, C. (2023). Electrostatic-Maillard formation of coconut protein Concentrate-Pectin conjugate for Oil-

- in-Water Emulsion: Effects of Ratio, Temperature, and pH. *Journal of the Saudi Society of Agricultural Sciences*, 22(1), 18–24.
<https://doi.org/10.1016/j.jssas.2022.05.004>
- Chagas, B. M. E., Dorado, C., Serapiglia, M. J., Mullen, C. A., Boateng, A. A., Melo, M. A. F., & Ataíde, C. H. (2016). Catalytic pyrolysis-GC/MS of *Spirulina*: Evaluation of a highly proteinaceous biomass source for production of fuels and chemicals. *Fuel*, 179, 124–134.
<https://doi.org/10.1016/j.fuel.2016.03.076>
- Chang, M., & Liu, K. (2024). *Arthrospira platensis* as future food: A review on functional ingredients, bioactivities and application in the food industry. *International Journal of Food Science & Technology*, 59(3), 1197–1212.
<https://doi.org/10.1111/ijfs.16882>
- Charnock, H. M., Pickering, G. J., & Kemp, B. S. (2022). The Maillard reaction in traditional method sparkling wine. *Frontiers in Microbiology*, 13, 979866.
<https://doi.org/10.3389/fmicb.2022.979866>
- Chen, W., Ma, X., Wang, W., Lv, R., Guo, M., Ding, T., Ye, X., Miao, S., & Liu, D. (2019). Preparation of modified whey protein isolate with gum acacia by ultrasound maillard reaction. *Food Hydrocolloids*, 95, 298–307.
<https://doi.org/10.1016/j.foodhyd.2018.10.030>
- Chen, Y., Chen, J., Chang, C., Chen, J., Cao, F., Zhao, J., Zheng, Y., & Zhu, J. (2019). Physicochemical and functional properties of proteins extracted from three microalgal species. *Food Hydrocolloids*, 96, 510–517.
<https://doi.org/10.1016/j.foodhyd.2019.05.025>
- Cheng, H.; Zhang, H.; Li, D.; Duan, H.; Liang, L. Impact of oil type on the location, partition and chemical stability of resveratrol in oil-in-water emulsions stabilized by whey protein isolate plus gum Arabic. *Food Hydrocoll.* 2020, 109, 106119.
- Chronakis, I. S., Nicoleta Galatanu, A., Nylander, T. and Lindman, B. (2000). The behaviour of protein preparations from blue-green algae (*Arthrospira platensis* strain Pacifica) at the air/water interface. www.elsevier.nl/locate/colsurfa
- Cortez-Trejo, M. C., Figueroa-Cárdenas, J. D., Quintanar-Guerrero, D., Baigts-Allende, D. K., Manríquez, J., & Mendoza, S. (2022). Effect of pH and protein-polysaccharide ratio on the intermolecular interactions between amaranth proteins and xanthan gum to produce electrostatic hydrogels. *Food Hydrocolloids*, 129, 107648. <https://doi.org/10.1016/j.foodhyd.2022.107648>
- Costa, A.V., B.C.B. Freitas, G.M. Rosa, L. Moraes, M.G. Morais, B.G. Mitchell, Operational and economic aspects of *Spirulina*-based biorefinery, *Bioresour. Technol.* 292 (2019), 121946, <https://doi.org/10.1016/j.biortech.2019.121946>.

- Dai, L., Hinrichs, J. and Weiss, J. (2020). Emulsifying properties of acidhydrolyzed insoluble protein fraction from *Chlorella protothecoides*: Formation and storage stability of emulsions. *Food Hydrocolloids*, 108.
- Damodaran S. Protein stabilization of emulsions and foams. *Journal of Food Sci* 2005;70: R54–66.
- De Meutter, J., & Goormaghtigh, E. (2021). Evaluation of protein secondary structure from FTIR spectra improved after partial deuteration. *European Biophysics Journal*, 50, 613-628.
- De Oliveira, F.C.; Coimbra, J.S.d.R.; de Oliveira, E.B.; Zuñiga, A.D.G.; Rojas, E.E.G. Food protein-polysaccharide conjugates obtained via the *Maillard* reaction: A review. *Crit. Rev. Food Sci. Nutr.* 2016, 56, 1108–1125.
- Dianingsih, N., Purnomo, E. H., & Muchtadi, T. R. (2016). Sifat Reologi dan Stabilitas Fisik Minuman Emulsi Minyak Sawit. *Jurnal Teknologi dan Industri Pangan*, 27(2), 165-174.
- Dickinson E. Hydrocolloids at interfaces and the influence on the properties of dispersed systems. *Food Hydrocoll* 2003;17:25–39.
- Ding, D. (2021, June). Effects of emulsifier on emulsification, physical and chemical properties of soybean protein. In *IOP Conference Series: Earth and Environmental Science* (Vol. 792, No. 1, p. 012017). IOP Publishing.
- Djamaludin, H., & Chamidah, A. (2021). Kualitas ekstrak minyak mikroalga *Spirulina* sp. dengan metode ekstraksi yang berbeda. *Prosiding Simposium Nasional Kelautan dan Perikanan*, 8.
- Dong, D.; Hua, Y. Glycinin-gum arabic complex formation: Turbidity measurement and charge neutralization analysis. *Food Res. Int.* 2016, 89, 709–715.
- Dong, Z., Yu, S., Zhai, K., Bao, N., Rashed, M. M. A., & Wu, X. (2023). Fabrication and Characterization of Complex Coacervation: The Integration of Sesame Protein Isolate-Polysaccharides. *Foods*, 12(19), 3696. <https://doi.org/10.3390/foods12193696>
- Du, Y., Shi, S., Jiang, Y., Xiong, H., Woo, M. W., Zhao, Q., Bai, C., Zhou, Q., & Sun, W. (2013). Physicochemical properties and emulsion stabilization of rice dreg glutelin conjugated with κ -carrageenan through *Maillard* reaction. *Journal of the Science of Food and Agriculture*, 93(1), 125–133. <https://doi.org/10.1002/jsfa.5739>
- Durowoju, I. B., Bhandal, K. S., Hu, J., Carpick, B., & Kirkitadze, M. (2017). Differential Scanning Calorimetry — A Method for Assessing the Thermal Stability and Conformation of Protein Antigen. *Journal of Visualized Experiments*, 121, 55262. <https://doi.org/10.3791/55262>
- Eghbal, N.; Yarmand, M.S.; Mousavi, M.; Degraeve, P.; Oulahal, N.; Gharsallaoui, A. Complex coacervation for the development of composite edible films based on LM pectin and sodium caseinate. *Carbohydr. Polym.* 2016, 151, 947–956.

- Elise, C. Y., Syafrizayanti, S., & Salim, M. (2021). Pemurnian Fikosianin dari *Spirulina platensis* dengan Metode Liquid Biphasic Flotation (LBF) dan Penentuan Aktivitas Antioksidannya. *Jurnal Riset Kimia*, 12(2).
- Fathollahy, I., Farmani, J., Kasaai, M. R. and Hamishehkar, H. (2021). Characteristics and functional properties of Persian lime (*Citrus latifolia*) seed protein isolate and enzymatic hydrolysates. *LWT*, 140.
- Feng, S., Guo, Y., Liu, F., Li, Z., Chen, K., Handa, A., & Zhang, Y. (2023). The impacts of complexation and glycated conjugation on the performance of soy protein isolate-gum Arabic composites at the o/w interface for emulsion-based delivery systems. *Food Hydrocolloids*, 135, 108168. <https://doi.org/10.1016/j.foodhyd.2022.108168>
- Garcia, E. S., Van Leeuwen, J. J. A., Safi, C., Sijtsma, L., Van Den Broek, L. A. M., Eppink, M. H. M., Wijffels, R. H., & Van Den Berg, C. (2018). Techno-Functional Properties of Crude Extracts from the Green Microalga *Tetraselmis suecica*. *Journal of Agricultural and Food Chemistry*, 66(29), 7831–7838. <https://doi.org/10.1021/acs.jafc.8b01884>
- Geada, P., Moreira, C., Silva, M., Nunes, R., Madureira, L., Rocha, C. M. R., Pereira, R. N., Vicente, A. A. and Teixeira, J. A. (2021). Algal proteins: Production strategies and nutritional and functional properties. *Bioresource Technology*, 332.
- Genicot, S., Pr'échoux, A., Correc, G., Kervarec, N., Simon, G., Craigie, J.S., 2018. Carrageenans: new tools for new applications, in: *Blue Biotechnology*. John Wiley & Sons, Ltd, pp. 371–416. doi: 10.1002/9783527801718.ch12.
- Gentile, L. Protein-polysaccharide interactions and aggregates in food formulations. *Curr. Opin. Colloid Interface Sci.* 2020, 48, 18–27.
- He, S. (2023). Study on Physicochemical Properties of Food Protein. *Molecules*, 28(24), 8145. <https://doi.org/10.3390/molecules28248145>
- He, W., Xiao, N., Zhao, Y., Yao, Y., Xu, M., Du, H., Wu, N., & Tu, Y. (2021). Effect of polysaccharides on the functional properties of egg white protein: A review. *Journal of Food Science*, 86(3), 656–666. <https://doi.org/10.1111/1750-3841.15651>
- Hedenskog, G., and Hofsten, A. v. 1970. The Ultrastructure of *Arthrospira platensis*A New Source of Microbial Protein. v.23.
- Hokazono, E., Ota, E., Goto, T., Fukumoto, S., Kayamori, Y., Uchiumi, T., & Osawa, S. (2021). Development of a protein assay with copper chelator chromeazurol B, based on the biuret reaction. *Analytical Biochemistry*, 630, 114320.
- Huang, Y., Bai, Y., Jin, W., Shen, D., Lyu, H., Zeng, L., ... & Liu, Y. (2021). Common Pitfalls and Recommendations for Using a Turbidity Assay to Study Protein Phase Separation. *Biochemistry*, 60(32), 2447-2456.
- Ibanoglu, E. (2005). Effect of hydrocolloids on the thermal denaturation of proteins. *Food Chemistry*, 90(4), 621–626. <https://doi.org/10.1016/j.foodchem.2004.04.022>

- Ismail, H. A., Richard, I., Ramaiya, S. D., Zakaria, M. H., & Lee, S. Y. (2023). Browning in Relation to Enzymatic Activities and Phytochemical Content in Terap Peel (*Artocarpus odoratissimus* Blanco) during Postharvest Ripening. *Horticulturae*, 9(1), 57.
- Ji, S., Correding, M., & Goff, H. D. (2008). Aggregation of casein micelles and κ -carrageenan in reconstituted skim milk. *Food Hydrocolloids*, 22, 56–64.
- Käferböck, A., Smetana, S., de Vos, R., Schwarz, C., Toepfl, S. and Parniakov, O. (2020). Sustainable extraction of valuable components from *Spirulina* assisted by pulsed electric fields technology. *Algal Research*, 48.
- Kamba, E. A., Itodo, A. U., & Ogah, E. (2013). Utilization of different emulsifying agents in the preparation and stabilization of emulsions. *International Journal of Materials and Chemistry*, 3(4), 69-74.
- Kato, A.; Minaki, K.; Kobayashi, K. Improvement of emulsifying properties of egg white proteins by the attachment of polysaccharide through *Maillard* reaction in a dry state. *J. Agric. Food Chem.* 1993, 41, 540–543.
- Khoo, K. S., Chew, K. W., Yew, G. Y., Leong, W. H., Chai, Y. H., Show, P. L., & Chen, W.-H. (2020). Recent advances in downstream processing of microalgae lipid recovery for biofuel production. *Bioresource Technology*, 304, 122996. <https://doi.org/10.1016/j.biortech.2020.122996>
- Kumar, K., Srivastav, S., and Sharanagat, V.S. 2021. Ultrasound assisted extraction (UAE) of bioactive compounds from fruit and vegetable processing byproducts: A review. *Ultrasonics Sonochemistry* <https://doi.org/10.1016/j.ultsonch.2020.10532>
- Lam RSH, Nickerson MT. Food proteins: a review on their emulsifying properties using a structure–function approach. *Food Chem* 2013;141:975–84.
- Li, D., Wu, G., Zhang, H., & Qi, X. (2020). The soy protein isolate-Octacosanol-polysaccharides nanocomplex for enhanced physical stability in neutral conditions: Fabrication, characterization, thermal stability. *Food Chemistry*, 322, 126638. <https://doi.org/10.1016/j.foodchem.2020.126638>
- Li, Y.; Zhang, X.; Zhao, Y.; Ding, J.; Lin, S. Investigation on complex coacervation between fish skin gelatin from cold-water fish and gum arabic: Phase behavior, thermodynamic, and structural properties. *Food Res. Int.* 2018, 107, 596–604.
- Lim, H.R., K.S. Khoo, K.W. Chew, C.-K.K. Chang, H.S.H. Munawaroh, P.S. Kumar, N.D. Huy, P.L. Show, Perspective of *Spirulina* culture with wastewater into a sustainable circular bioeconomy, *Environ. Pollut.* 284 (2021), 117492, <https://doi.org/10.1016/j.envpol.2021.117492>.
- Lin, S., Yang, X., Jia, S., Weeks, A. M., Hornsby, M., Lee, P. S., ... & Chang, C. J. (2017). Redox-based reagents for chemoselective methionine bioconjugation. *Science*, 355(6325), 597-602.
- Liu, Y., Zhao, G., Zhao, M., Ren, J., & Yang, B. (2012). Improvement of functional properties of peanut protein isolate by conjugation with dextran through

- Maillard reaction. *Food Chemistry*, 131(3), 901–906.
<https://doi.org/10.1016/j.foodchem.2011.09.074>
- Lowry, O. H., Rosebrough, N. J., Farr, A. L. and Randall, R. J. (1951). PROTEIN MEASUREMENT WITH THE FOLIN PHENOL REAGENT*.
- Lund, M. N., & Ray, C. A. (2017). Control of Maillard reactions in foods: Strategies and chemical mechanisms. *Journal of agricultural and food chemistry*, 65(23), 4537-4552.
- Magpusao, J., Giteru, S., Oey, I. and Kebede, B. (2021). Effect of high pressure homogenization on microstructural and rheological properties of *A. platensis*, *Isochrysis*, *Nannochloropsis* and *Tetraselmis* species. *Algal Research*, 56.
- Maleki, S. J., & Hurlburt, B. K. (2002). Food allergy: recent advances in food allergy research.
- Mao, Y., Huang, M., Bi, J., Sun, D., Li, H., & Yang, H. (2023). Effects of kappa-carrageenan on egg white ovalbumin for enhancing the gelation and rheological properties via electrostatic interactions. *Food Hydrocolloids*, 134, 108031. <https://doi.org/10.1016/j.foodhyd.2022.108031>
- Martinez-Alvarenga, M. S., Martinez-Rodriguez, E. Y., Garcia-Amezquita, L. E., Olivas, G. I., Zamudio-Flores, P. B., Acosta-Muniz, C. H., & Sepulveda, D. R. (2014). Effect of Maillard reaction conditions on the degree of glycation and functional properties of whey protein isolate – Maltodextrin conjugates. *Food Hydrocolloids*, 38, 110–118.
<https://doi.org/10.1016/j.foodhyd.2013.11.006>.
- Maruszczak, K., Rasmussen, C., Ceutz, F. R., Ørgaard, A., Elmelund, E., Richter, M. M., ... & Wewer Albrechtsen, N. J. (2022). Arginine-induced glucagon secretion and glucagon-induced enhancement of amino acid catabolism are not influenced by ambient glucose levels in mice. *American Journal of Physiology-Endocrinology and Metabolism*, 323(3), E207-E214.
- Matos, Â.P. 2019 “Microalgae as a Potential Source of Proteins.” In *Proteins: Sustainable Source, Processing and Applications*, pp. 63–96. Elsevier.
<https://doi.org/10.1016/b978-0-12-816695-6.00003-9>
- Mauliasari, E. S., Agustini, T. W., & Amalia, U. (2019). Stabilisasi fikosiani *Spirulina platensis* dengan perlakuan mikroenkapsulasi dan pH. *Jurnal Pengolahan Hasil Perikanan Indonesia*, 22(3), 526-534.
- McClements DJ. *Food emulsions: principles, practices, and techniques*. Third edition ed. Boca Raton, FL: CRC Press; 2015
- McClements, D. J., & Gumus, C. E. (2016). Natural emulsifiers—Biosurfactants, phospholipids, biopolymers, and colloidal particles: Molecular and physicochemical basis of functional performance. *Advances in Colloid and interface Science*, 234, 3-26.
- McClements, D. J., L. Bai, C. Chung, Recent advances in the utilization of natural emulsifiers to form and stabilize emulsions, *Annu. Rev. Food Sci. Technol.* 8 (2017) 205–236, <https://doi.org/10.1146/annurev-food-030216-030154>.

- McHugh, D.J., 2003. A guide to the seaweed industry. FAO Fish. Tech. Pap. 441, Food and Agricultural Organization of the United Nations (FAO), Rome. 105p
- Menegotto, A.L.L., Souza, L.E.S. de, Colla, L.M., Costa, J.A.V., Sehn, E., Bittencourt, P.R.S., Moraes Flores, É.L. de, Canan, C., and Colla, E. 2019. "Investigation of techno-functional and physicochemical properties of *Arthrospira platensis* protein concentrate for food enrichment." *LWT* 114: 1–8
<https://doi.org/10.1016/j.lwt.2019.108267>
- Mir, N. A., Riar, C. S., & Singh, S. (2021). Improvement in the functional properties of quinoa (*Chenopodium quinoa*) protein isolates after the application of controlled heat-treatment: Effect on structural properties. *Food Structure*, 28, 100189.
- Necas, J., Bartosikova, L., 2013. Carrageenan: a review. *Veterinarní ´ Medicina* 58, 187–205. <https://doi.org/10.17221/6758-VETMED>.
- Nooshkam, M., Varidi, M., Zareie, Z., & Alkobeisi, F. (2023). Behavior of protein-polysaccharide conjugate-stabilized food emulsions under various destabilization conditions. *Food Chemistry: X*, 18, 100725. <https://doi.org/10.1016/j.fochx.2023.100725>
- Nursten, H. E. (2005). *The Maillard Reaction: Chemistry, Biochemistry and Implications*. Cambridge: The Royal Society of Chemistry.
- Ossa, J. S. H., Wagner, J. R., & Palazolo, G. G. (2022). Impact of environmental stresses on the stability of acidic oil-in-water emulsions prepared with tofu whey concentrates. *Current Research in Food Science*, 5, 498-505.
- Parimi, N.S., M. Singh, J.R. Kastner, K.C. Das, L.S. Forsberg, P. Azadi, Optimization of protein extraction from *Arthrospira platensis* to generate a potential co-product and a biofuel feedstock with reduced nitrogen content, *Front. Energy Res.* 3 (2015) 1–9, <https://doi.org/10.3389/fenrg.2015.00030>.
- Park, W., Kim, H.-J., Li, M., Lim, D., Kim, J., Kwak, S.-S., Kang, C.-M., Ferruzzi, M., & Ahn, M.-J. (2018). Two Classes of Pigments, Carotenoids and C-Phycocyanin, in Spirulina Powder and Their Antioxidant Activities. *Molecules*, 23(8), 2065. <https://doi.org/10.3390/molecules23082065>
- Parveen, I., M. Maraz, K., Iqbal Mahmud, Md., & A. Khan, R. (2019). Seaweed Based Bio Polymeric Film and Their Application: A Review on Hydrocolloid Polysaccharides. *Scientific Review*, 55, 93–102. <https://doi.org/10.32861/sr.55.93.102>
- Pastoriza, S., Rufián-Henares, J. Á., García-Villanova, B., & Guerra-Hernández, E. (2016). Evolution of the Maillard reaction in glutamine or arginine-dextrinomaltose model systems. *Foods*, 5(4), 86.
- Perrechil, F. A., & Cunha, R. L. (2013). Stabilization of multilayered emulsions by sodium caseinate and kappa- carrageenan. *Food Hydrocolloids*, 30, 606–613.
- Phong, W.N., Show, P.L., Ling, T.C., Juan, J.C., Ng, E.P., and Chang, J.S. 2018. "Mild cell disruption methods for bio-functional proteins recovery from

- microalgae—Recent developments and future perspectives.” *Algal Research* 31: 506–516 <https://doi.org/10.1016/j.algal.2017.04.005>
- Piculell, L., 2006. Gelling carrageenans. In: Stephen, A.M., Phillips, G.O. (Eds.), *Food Polysaccharides and Their Applications*, 2nd Edition, Chapter 8. Taylor & Francis, CRC Press, pp. 239–287.
- Pillai, P.K.S.; Stone, A.K.; Guo, Q.; Guo, Q.; Wang, Q.; Nickerson, M.T. Effect of alkaline de-esterified pectin on the complex coacervation with pea protein isolate under different mixing conditions. *Food Chem.* 2019, 284, 227–235.
- Pirestani, S., Nasirpour, A., Keramat, J., & Desobry, S. (2017). Preparation of chemically modified canola protein isolate with gum Arabic by means of *Maillard* reaction under wet-heating conditions. *Carbohydrate Polymers*, 155, 201–207.
- Poojary, M. M., & Lund, M. N. (2022). Chemical Stability of Proteins in Foods: Oxidation and the Maillard Reaction. *Annual Review of Food Science and Technology*, 13(1), 35–58. <https://doi.org/10.1146/annurev-food-052720-104513>
- Prihastuti, D., & Abdassah, M. (2019). Karaginan dan Aplikasinya di Bidang Farmasetika. *Majalah Farmasetika*, 4(5), 146-154.
- Purdi, T. S., Setiowati, A. D., & Ningrum, A. (2023). Ultrasound-assisted extraction of *Spirulina platensis* protein: Physicochemical characteristic and techno-functional properties. *Journal of Food Measurement and Characterization*, 17(5), 5474–5486. <https://doi.org/10.1007/s11694-023-02051-y>
- Purnamayati, L., Dewi, E. N., & Kurniasih, R. A. (2016). Karakteristik fisik mikrokapsul fikosianin spirulina pada konsentrasi bahan penyalut yang berbeda. *J. Teknol. Has. Pertan*, 9, 1-8.
- Rizwan, M., Mujtaba, G., Memon, S. A., Lee, K., & Rashid, N. (2018). Exploring the potential of microalgae for new biotechnology applications and beyond: A review. *Renewable and Sustainable Energy Reviews*, 92, 394–404. <https://doi.org/10.1016/j.rser.2018.04.034>
- Rusli, Z., & Setiani, L. A. (2020). Modifikasi Metode Analisis Daya Hambat terhadap Proses Denaturasi Protein yang Diinduksi oleh Panas. *Chemical Engineering Research Articles*, 3(2), 55-62.
- Safi, C., Charton, M., Pignolet, O., Silvestre, F., Vaca-Garcia, C., and Pontalier, P.Y. 2013. “Influence of microalgae cell wall characteristics on protein extractability and determination of nitrogen-to-protein conversion factors.” *Journal of Applied Phycology* 25 (2): 523–529 <https://doi.org/10.1007/s10811-012-9886-1>
- Schwenzfeier, A., Lech, F., Wierenga, P. A., Eppink, M. H. M. and Gruppen, H. (2013). Foam properties of algae soluble protein isolate: Effect of pH and ionic strength. *Food Hydrocolloids*, 33: 111–117.
- Seo, C. W., & Yoo, B. (2022). Effect of Milk Protein Isolate/ κ -Carrageenan Conjugates on Rheological and Physical Properties of Whipping Cream: A Comparative

- Study of Maillard Conjugates and Electrostatic Complexes. *Food Science of Animal Resources*, 42(5), 889–902. <https://doi.org/10.5851/kosfa.2022.e42>
- Setiowati, A. D., Saeedi, S., Wijaya, W., & Van der Meeren, P. (2017). Improved heat stability of whey protein isolate stabilized emulsions via dry heat treatment of WPI and low methoxyl pectin: Effect of pectin concentration, pH, and ionic strength. *Food Hydrocolloids*, 63, 716–726.
- Setiowati, A. D., Wijaya, W., & Van Der Meeren, P. (2020). Whey protein-polysaccharide conjugates obtained via dry heat treatment to improve the heat stability of whey protein stabilized emulsions. *Trends in Food Science & Technology*, 98, 150–161. <https://doi.org/10.1016/j.tifs.2020.02.011>
- Shen, Y., Hong, S., Singh, G., Koppel, K., & Li, Y. (2022). Improving functional properties of pea protein through “green” modifications using enzymes and polysaccharides. *Food Chemistry*, 385, 132687. <https://doi.org/10.1016/j.foodchem.2022.132687>
- Shmueli, M. D., Hizkiahou, N., Peled, S., Gazit, E., & Segal, D. (2017). Total proteome turbidity assay for tracking global protein aggregation in the natural cellular environment. *Journal of Biological Methods*, 4(2).
- Silva, S. C., Almeida, T., Colucci, G., Santamaria-Echart, A., Manrique, Y. A., Dias, M. M., & Barreiro, M. F. (2022). Spirulina (*Arthrospira platensis*) protein-rich extract as a natural emulsifier for oil-in-water emulsions: Optimization through a sequential experimental design strategy. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 648, 129264.
- Singh, K., Tripathi, S., & Chandra, R. (2021). Maillard reaction product and its complexation with environmental pollutants: A comprehensive review of their synthesis and impact. *Bioresource Technology Reports*, 15, 100779.
- Soto-Sierra, L., Stoykova, P. and Nikolov, Z. L. (2018). Extraction and fractionation of microalgae-based protein products. *Algal Research*, 36: 175– 192
- Sovia, E., Sasongko, L. D. N., & Sigit, J. I. (2014). Aktivitas inhibisi ekstrak bawang putih dan S-metil sistein terhadap reaksi glikasi albumin secara in vitro. *Maranatha Journal of Medicine and Health*, 10(2), 150879.
- Srivastava, A. K., Pandey, A. K., Jain, S., & Misra, N. (2015). FT-IR spectroscopy, intra-molecular C–H···O interactions, HOMO, LUMO, MESP analysis and biological activity of two natural products, triclisine and rufescine: DFT and QTAIM approaches. *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy*, 136, 682–689. <https://doi.org/10.1016/j.saa.2014.09.082>
- Subhashree, S. N., Sunoj, S., Xue, J., & Bora, G. C. (2017). Quantification of browning in apples using colour and textural features by image analysis. *Food Quality and Safety*, 1(3), 221–226.
- Sun, X., Wang, H., Li, S., Song, C., Zhang, S., Ren, J., & Udenigwe, C. C. (2022). Maillard-Type Protein–Polysaccharide Conjugates and Electrostatic Protein–Polysaccharide Complexes as Delivery Vehicles for Food Bioactive

- Ingredients: Formation, Types, and Applications. *Gels*, 8(2), 135. <https://doi.org/10.3390/gels8020135>
- Suseno, R., Palupi, N. S., & Prangdimurti, E. (2016). Alergenisitas sistem glikasi isolat protein kedelai-fruktooligosakarida. *Agritech*, 36(4), 450-458.
- Taragjini, E., Ciardi, M., Musari, E., Villaró, S., Morillas-España, A., Alarcón, F. J., & Lafarga, T. (2022). Pilot-scale production of *A. platensis*: protein isolation following an ultrasound-assisted strategy and assessment of techno-functional properties. *Food and Bioprocess Technology*, 15(6), 1299-1310. <https://doi.org/10.1007/s11947-022-02789-1>
- Tatulian, S. A. (2019). FTIR analysis of proteins and protein–membrane interactions. *Lipid-Protein Interactions: Methods and Protocols*, 281-325.
- Teuling, E., Schrama, J. W., Gruppen, H. and Wierenga, P. A. (2019). Characterizing emulsion properties of microalgal and cyanobacterial protein isolates. *Algal Research*, 39.
- Usui, M.; Tamura, H.; Nakamura, K.; Ogawa, T.; Muroshita, M.; Azakami, H.; Kanuma, S.; Kato, A. Enhanced bactericidal action and masking of allergen structure of soy protein by attachment of chitosan through *Maillard*-type protein-polysaccharide conjugation. *Nahrung* 2004, 48, 69–72
- van de Velde, F., de Hoog, E. H., Oosterveld, A., & Tromp, R. H. (2015). Protein-polysaccharide interactions to alter texture. *Annual review of food science and technology*, 6, 371-388.
- van Outersterp, R. E., Moons, S. J., Engelke, U. F., Bentlage, H., Peters, T. M., van Rooij, A., ... & Martens, J. (2021). Amadori rearrangement products as potential biomarkers for inborn errors of amino-acid metabolism. *Communications biology*, 4(1), 367.
- Wang, J., Zheng, H., Zhang, S., Li, J., Zhu, X., Jin, H., & Xu, J. (2021). Improvement of protein emulsion stability through glycosylated black bean protein covalent interaction with (–)-epigallocatechin-3-gallate. *RSC advances*, 11(4), 2546-2555.
- Wang, K., Li, Y., Sun, J., & Zhang, Y. (2023). The physicochemical properties and stability of myofibrillar protein oil-in-water emulsions as affected by the structure of sugar. *Food Chemistry: X*, 18, 100677.
- Wang, Q., Wang, Y., Huang, M., Hayat, K., Kurtz, N. C., Wu, X., Ahmad, M., & Zheng, F. (2021). Ultrasound-assisted alkaline proteinase extraction enhances the yield of pecan protein and modifies its functional properties. *Ultrasonics Sonochemistry*, 80, 105789. <https://doi.org/10.1016/j.ultsonch.2021.105789>
- Wang, Q., Xiang, X., Xie, Y., Wang, K., Wang, C., Nie, X., & Wang, P. (2022). Maillard reaction between oligopeptides and reducing sugar at body temperature: The putative anti-glycation agents. *Frontiers in Nutrition*, 9, 1062777.
- Wang, W., Sheng, H., Zhou, J., Yuan, P., Zhang, X., Lu, M., & Gu, R. (2021). The effect of a variable initial pH on the structure and rheological properties of

- whey protein and monosaccharide gelation via the Maillard reaction. *International Dairy Journal*, 113, 104896. <https://doi.org/10.1016/j.idairyj.2020.104896>
- Wang, Y., Gan, J., Li, Y., Nirasawa, S., & Cheng, Y. (2019). Conformation and emulsifying properties of deamidated wheat gluten-maltodextrin/citrus pectin conjugates and their abilities to stabilize β -carotene emulsions. *Food Hydrocolloids*, 87, 129–141. <https://doi.org/10.1016/j.foodhyd.2018.07.050>
- Wang, Y., Yuan, C., Cui, B., & Liu, Y. (2018). Influence of cations on texture, compressive elastic modulus, sol-gel transition and freeze-thaw properties of kappa-carrageenan gel. *Carbohydrate Polymers*, 202, 530–535. <https://doi.org/10.1016/j.carbpol.2018.08.146>
- Wang, Zhang, W., & Ren, F. (2017). Effect of carrageenan addition on the rennet-induced gelation of skim milk. *Journal of the Science of Food and Agriculture*, 97(2), 4178–4182.
- Warnakulasuriya, S.N.; Nickerson, M.T. Review on plant protein-polysaccharide complex coacervation, and the functionality and applicability of formed complexes. *J. Sci. Food Agric.* 2018, 98, 5559–5571
- Wen, C., Zhang, J., Qin, W., Gu, J., Zhang, H., Duan, Y., & Ma, H. (2020). Structure and functional properties of soy protein isolate-lentinan conjugates obtained in Maillard reaction by slit divergent ultrasonic assisted wet heating and the stability of oil-in-water emulsions. *Food Chemistry*, 331, 127374. <https://doi.org/10.1016/j.foodchem.2020.127374>
- Wong, C. W., Wijayanti, H. B., & Bhandari, B. R. (2015). Maillard reaction in limited moisture and low water activity environment. *Water stress in biological, chemical, pharmaceutical and food systems*, 41-63.
- Xiao, Q., Bai, X., & He, Y. (2020). Rapid screen of the color and water content of fresh-cut potato tuber slices using hyperspectral imaging coupled with multivariate analysis. *Foods*, 9(1), 94.
- Xu, Y., Han, M., Huang, M., & Xu, X. (2021). Enhanced heat stability and antioxidant activity of myofibrillar protein-dextran conjugate by the covalent adduction of polyphenols. *Food Chemistry*, 352, 129376. <https://doi.org/10.1016/j.foodchem.2021.129376>
- Yang, A., Deng, H., Zu, Q., Lu, J., Wu, Z., Li, X., ... & Chen, H. (2018). Structure characterization and IgE-binding of soybean 7S globulin after enzymatic deglycosylation. *International Journal of Food Properties*, 21(1), 171-182.
- Yüce-tepe, A., Yavuz-Düzgün, M., Şensu, E., Bildik, F., Demircan, E., & Özçelik, B. (2021). The impact of pH and biopolymer ratio on the complex coacervation of *Arthrospira platensis* protein concentrate with chitosan. *Journal of Food Science and Technology*, 58(4), 1274–1285. <https://doi.org/10.1007/s13197-020-04636-7>
- Zha, F., Dong, S., Rao, J., & Chen, B. (2019). The structural modification of pea protein concentrate with gum Arabic by controlled Maillard reaction enhances its

- functional properties and flavor attributes. *Food Hydrocolloids*, 92, 30–40. <https://doi.org/10.1016/j.foodhyd.2019.01.046>
- Zhai JL, Wooster TJ, Hoffmann SV, Lee TH, Augustin MA, Aguilar MI. Structural rearrangement of beta-lactoglobulin at different oil–water interfaces and its effect on emulsion stability. *Langmuir* 2011;27:9227–36.
- Zhang, A., Yu, J., Wang, G., Wang, X., & Zhang, L. (2019). Improving the emulsion freeze-thaw stability of soy protein hydrolysate-dextran conjugates. *LWT-Food Science and Technology*, 116, 108506.
- Zhang, C., Ning, Y., Jia, Y., Kang, M., He, Y., Xu, W., & Shah, B. R. (2022). Interaction investigation and phase transition of carrageenan/lysozyme complex system. *Food Science and Technology*, 42.
- Zhang, Q., Ames, J. M., Smith, R. D., Baynes, J. W., & Metz, T. O. (2009). A perspective on the Maillard reaction and the analysis of protein glycation by mass spectrometry: probing the pathogenesis of chronic disease. *Journal of proteome research*, 8(2), 754-769.
- Zhang, X., Wang, Q., Liu, Z., Zhi, L., Jiao, B., Hu, H., Ma, X., Agyei, D., & Shi, A. (2023). Plant protein-based emulsifiers: Mechanisms, techniques for emulsification enhancement and applications. *Food Hydrocolloids*, 144, 109008. <https://doi.org/10.1016/j.foodhyd.2023.109008>
- Zhang, Z., Holden, G., Wang, B., & Adhikari, B. (2023). Maillard reaction-based conjugation of Spirulina protein with maltodextrin using wet-heating route and characterisation of conjugates. *Food Chemistry*, 406, 134931. <https://doi.org/10.1016/j.foodchem.2022.134931>
- Zhang, Z., Wang, B., Holden, G., Chen, J., & Adhikari, B. (2023). Improving functional properties of Spirulina protein by covalent conjugation followed by complex coacervation processes. *Future Foods*, 7, 100239. <https://doi.org/10.1016/j.fufo.2023.100239>
- Zhou, X., Iqbal, A., Li, J., Liu, C., Murtaza, A., Xu, X., ... & Hu, W. (2021). Changes in browning degree and reducibility of polyphenols during autoxidation and enzymatic oxidation. *Antioxidants*, 10(11), 1809.
- Zia, K.M., Tabasum, S., Nasif, M., Sultan, N., Aslam, N., Noreen, A., Zuber, M., 2017. A review on synthesis, properties and applications of natural polymer based carrageenan blends and composites. *Int. J. Biol. Macromol.* 96, 282–301. <https://doi.org/10.1016/j.ijbiomac.2016.11.095>.
- Zinoviadou, K.G.; Scholten, E.; Moschakis, T.; Biliaderis, C.G. Properties of emulsions stabilised by sodium caseinate-chitosan complexes. *Int. Dairy J.* 2012, 26, 94–101.