UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

DAFTAR PUSTAKA

Abdelwahab, N., W. Rabie, and F. Mohamed. 2023. Fabrication and characterization of novel biocomposite based on *Sargassum vulgare* for controlling sugar beet root diseases. Chemical and Biological Technologies in Agriculture 10: 52.

Abka-Khajouei, R., L. Tounsi, N. Shahabi, A.K. Patel, S. Abdelkafi, and P. Michaud. 2022. Structures, properties and applications of alginates. Marine Drugs 20(6): 364.

Afgatiani, P.M., A. Husni, dan S.A. Budhiyanti. 2020. Aktivitas antioksidan bubuk *Sargassum hystrix* selama penyimpanan pada suhu berbeda. agriTECH 40(3): 175-181.

Akopova, T. A., Popyrina, T. N., dan Demina, T. S. 2022. Mechanochemical transformations of polysaccharides: A systematic review. *International Journal of Molecular Sciences* 23(18): 10458.

Altammar, K.A. 2023. A review on nanoparticles: characteristics, synthesis, applications, and challenges. Frontiers in Microbiology 14: 1155622.

Amaya, A.J., B. Lima, and L.A. Rocha. 2020. Influence of penggilingan parameters on particle size of bio-based materials using *planetary ball mill*. Powder Technology 364: 404-412.

Ambra, R., Pastore, G., dan Natella, F. 2023. The fate of chlorophylls in alkali-treated green table olives: A review. *Molecules* 28(18): 6673.

Angelopoulou, P., E. Giaouris, dan K. Gardikis. 2022. Applications and prospects of nanotechnology in food and cosmetics preservation. Nanomaterials 12(7): 1196.

Anselmo, A. C., dan S. Mitragotri. 2019. Nanoparticles in the clinic: An update. Bioengineering & Translational Medicine 4(3): e10143.

Antony, A. and M. Farid. 2022. Effect of temperatures on polyphenols during extraction. Applied Sciences 12(4): 2107.

Arce, C. and L. Krátký. 2025. Investigating the effect of process variables for *ball* penggilingan of wood chips: Energy demand and particle size. Biomass Conversion and Biorefinery 15: 3361-3371.

Asmara, A.P., H. Hernawan, N. Nurhayati, and T.H. Sugara. 2024. Effect of high energy *ball* penggilingan on the phenolic extractability and antioxidant activity of *Sargassum polycystum* C. Agardh. AIP Conference Proceedings 2957(1): 060038.

Badia-Olmos, C., Laguna, L., Haros, C. M., dan Tárrega, A. 2023. Techno-functional and rheological properties of alternative plant-based flours. *Foods* 12(7): 1411.

Baek, S., L. Cao, H. Lee, Y. Lee, and S. Lee. 2021. Effects of UV and heating on the stability of fucoxanthin, total phlorotannin and total antioxidant capacities in

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Saccharina japonica ethanol extract and solvent fractions. Applied Sciences 11(17): 7831.

Bagale, U., *et al.* 2023. Prospect of bioactive curcumin nanoemulsion as effective agency to improve milk based soft cheese by using ultrasound encapsulation approach. International Journal of Molecular Sciences 24(3): 2663.

Baig, N., I. Kammakakam, and W. Falath. 2021. Nanomaterials: A review of synthesis methods, properties, recent progress, and challenges. Materials Advances 2(6): 1821-1871.

Baláž, P., M. Achimovičová, M. Baláž, P. Billik, Z. Cherkezova-Zheleva, J.M. Criado, F. Delogu, E. Dutková, E. Gaffet, F.J. Gotor, R. Kumar, I. Mitov, T. Rojac, M. Senna, A. Streletskii, and K. Wieczorek-Ciurowa. 2013. Hallmarks of mechanochemistry: from nanoparticles to technology. Chemical Society Reviews 42(18): 7571-7637.

Beach, M.A., U. Nayanathara, Y. Gao, C. Zhang, Y. Xiong, Y. Wang, and G.K. Such. 2024. Polymeric nanoparticles for drug delivery. Chemical Reviews 124(9): 5505-5616.

Besednova, N.N., B.G. Andryukov, T.S. Zaporozhets, T.A. Kuznetsova, S.P. Kryzhanovsky, S.P. Ermakova, I.V. Galkina, and M.Yu. Shchelkanov. 2022. Molecular targets of brown algae phlorotannins for the therapy of inflammatory processes of various origins. Marine Drugs 20(4): 243.

Bhattacharjee, S. 2016. DLS and zeta potential—What they are and what they are not? *Journal of Controlled Release* 235: 337–351.

Birkemeyer, C., Lemesheva, V., Billig, S., dan Tarakhovskaya, E. 2020. Composition of intracellular and cell wall-bound phlorotannin fractions in fucoid algae indicates specific functions of these metabolites dependent on the chemical structure. *Metabolites* 10(9): 369.

Blanc, N., Mayer-Laigle, C., Frank, X., Radjai, F., dan Delenne, J.-Y. 2020. Evolution of grinding energy and particle size during dry ball-penggilingan of silica sand. *Powder Technology* 376: 661–667.

Böcker, L., T. Hostettler, M. Diener, S. Eder, T. Demuth, J. Adamcik, K. Reineke, E. Leeb, L. Nyström, and A. Mathys. 2020. Time-temperature-resolved functional and structural changes of phycocyanin extracted from Arthrospira platensis/*Spirulina*. Food Chemistry 316: 126374.

Brennan, J.G., J.R. Butters, N.D. Cowell, and A.E.V. Lilly. 1990. Food Engineering Operations. 3rd ed. Elsevier Applied Science, London.

Briguglio, M., Hrelia, S., Malaguti, M., Lombardi, G., Riso, P., Porrini, M., Perazzo, P., dan Banfi, G. 2020. The central role of iron in human nutrition: From folk to contemporary medicine. *Nutrients* 12(6): 1761.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Brunaugh, A. dan Smyth, H. D. C. 2018. Process optimization and particle engineering of micronized drug powders via penggilingan. *Drug Delivery and Translational Research* 8(6): 1740–1750.

Budhiyanti, S.A., S. Raharjo, D.W. Marseno, and I.Y.B. Lelana. 2011. Free radical scavenging, metal chelating and singlet oxygen quenching activity of fractionated brown seaweed *Sargassum hystrix* extract. Journal of Biological Sciences 11(4): 288-298.

Budhiyanti, S. A., Raharjo, S., Marseno, D. W., dan Lelana, I. Y. B. 2012. Antioxidant activity of brown algae *Sargassum* species extract from the coastline of Java Island. *American Journal of Agricultural and Biological Sciences* **7**(3): 337–346.

Burgos-Díaz, C., Garrido-Miranda, K. A., Palacio, D. A., Chacón-Fuentes, M., Opazo-Navarrete, M., dan Bustamante, M. 2023. Food-grade oil-in-water (O/W) Pickering emulsions stabilized by agri-food byproduct particles. *Colloids and Interfaces* 7(2): 27.

Burgos-Díaz, C., Garrido-Miranda, K. A., Palacio, D. A., Chacón-Fuentes, M., Opazo-Navarrete, M., dan Bustamante, M. 2023. Food-grade oil-in-water (O/W) Pickering emulsions stabilized by agri-food byproduct particles. *Colloids and Interfaces* 7(2): 27.

Burlec, A. F., Corciova, A., Boev, M., Batir-Marin, D., Mircea, C., Cioanca, O., Danila, G., Danila, M., Bucur, A. F., dan Hancianu, M. 2023. Current overview of metal nanoparticles' synthesis, characterization, and biomedical applications, with a focus on silver and gold nanoparticles. *Pharmaceuticals* 16(10): 1410.

Burmeister, C. F. dan Kwade, A. 2013. Process engineering with *planetary ball mill*s. *Chemical Society Reviews* 42(18): 7660–7667.

Buzea, C., I.I. Pacheco, and K. Robbie. 2007. Nanomaterials and nanoparticles: Sources and toxicity. Biointerphases 2(4): MR17-MR71.

Cao, J., M. Gao, J. Wang, Y. Liu, X. Zhang, dan Y. Ping. 2023. Construction of nano slow-release systems for antibacterial active substances and its applications: A comprehensive review. Frontiers in Nutrition 10: 1109204.

Catarino, M.D., R. Silva-Reis, A. Chouh, S. Silva, S.S. Braga, A.M.S. Silva, and S.M. Cardoso. 2023. Applications of antioxidant secondary metabolites of *Sargassum spp.* Marine Drugs 21(3): 172.

Červenka, L., M. Frühbauerová, J. Palarčík, S. Muriqi, and H. Velichová. 2022. The effect of vibratory grinding time on moisture sorption, particle size distribution, and phenolic bioaccessibility of carob powder. Molecules 27(22): 7689.

Chansoriya, T., B. Khilwani, and A.S. Ansari. 2023. Nanoparticle-Based Drug Delivery System for Beginners. In: Interaction of nanomaterials with living cells. Springer Nature Singapore, Singapore, p: 557-580.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Chaudhary, V., *et al.* 2021. Application of encapsulation technology in edible films: Carrier of bioactive compounds. Frontiers in Sustainable Food Systems 5: 734921.

Chaudhuri, S., R. Das, and S. Saha. 2021. Effect of high-energy *ball* penggilingan on physicochemical and bioactive properties of food powders. Food Biophysics 16(4): 455-467.

Chauhan, V.S., A. Kumar, and R.K. Sahu. 2018. Particle size reduction and its impact on bioavailability of bioactive compounds using *ball* penggilingan. International Journal of Pharmaceutics 550(1-2): 388-396.

Chehraghi, M., H. Jafarizadeh-Malmiri, A. Javadi, and N. Anarjan. 2023. Effects of planetary *ball* penggilingan and ultrasonication on the nutrients and physico-chemical and biological properties of the honey bee pollen. Journal of Food Measurement and Characterization 17: 3886-3895.

Chen, K. dan Roca, M. 2018. Cooking effects on chlorophyll profile of the main edible seaweeds. *Food Chemistry* 266: 368–374.

Chen, L., Ao, F., Ge, X., dan Shen, W. 2020. Food-grade Pickering emulsions: Preparation, stabilization and applications. *Molecules* 25(14): 3202.

Chen, X., M. Guo, Y. Sang, and J. Sun. 2022. Effect of *ball*-penggilingan treatment on the structure, physicochemical properties and allergenicity of proteins from oyster (*Crassostrea gigas*). LWT 166: 113803.

Chen, Y., L. Guzman, S. Potter, dan M. Khan. 2015. Application of PFC3D to simulate a *planetary ball mill*. Agricultural Engineering International: CIGR Journal 17(4): 235-246.

Chitrakar, B., M. Zhang, X. Zhang, and S. Devahastin. 2020. Bioactive dietary fiber powder from asparagus leaf by-product: Effect of low-temperature *ball* penggilingan on physico-chemical, functional and microstructural characteristics. Powder Technology 366: 275-282.

Chogale, M. M., Ghodake, V. N., dan Patravale, V. B. 2016. Performance parameters and characterizations of nanocrystals: A brief review. *Pharmaceutics* 8(3): 26.

Chouh, A., T. Nouadri, M.D. Catarino, A.M.S. Silva, and S.M. Cardoso. 2022. Phlorotannins of the brown algae *Sargassum* vulgare from the Mediterranean Sea coast. Antioxidants 11(6): 1055.

Cokrowati, N., Junaidi, M., Affandi, R. I., Sumsanto, M., Muahiddah, N., Anggraini, I. D., Marno, S., Asri, Y., Dwiyanti, S., Lumbessy, S. Y., Latifah, W., dan Fikri, R. A. 2024. The distribution, habitat characteristics, and bioenergy potential of *Sargassum* sp. in Indonesia. *International Journal of Design & Nature and Ecodynamics* 19(6): 2049–2062.

Colacino, E., M. Carta, G. Pia, A. Porcheddu, P.C. Ricci, and F. Delogu. 2018. Processing

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

and investigation methods in mechanochemical kinetics. ACS Omega 3(8): 9196-9209.

Cormick, G. dan Belizán, J. M. 2019. Calcium intake and health. *Nutrients* 11(7): 1606.

Cutshaw, A., H. Frost, S. Uludag-Demirer, Y. Liu, and W. Liao. 2023. Protein extraction, precipitation, and recovery from *Chlorella sorokiniana* using mechanochemical methods. Energies 16(12): 4809.

Damayanti, P.K., A. Husni, and S.A. Budhiyanti. 2021. Antioxidant activity and consumer preference of brown algae *Sargassum hystrix* juice as a functional drink. agriTECH 41(3): 231-237.

Davtalab, M., Naji-Tabasi, S., Shahidi-Noghabi, M., Martins, A. J., Bourbon, A. I., dan Cerqueira, M. A. 2024. Pickering emulsion stabilized by different concentrations of whey protein–cress seed gum nanoparticles. *Foods* 13(23): 3777.

de Assunção, M.A.S., D. Dourado, D.R. dos Santos, G.B. Faierstein, M.E.M. Braga, S. Alves Junior, R.M.R. Barbosa, H.J.C. de Sousa, and F.R. Formiga. 2024. Green synthesis of silver nanoparticles derived from algae and their larvicidal properties to control *Aedes aegypti*. Beilstein Journal of Nanotechnology 15: 1566-1575.

de Oliveira, P.F.M., R.M. Torresi, F. Emmerling, and P.H.C. Camargo. 2020. Challenges and opportunities in the bottom-up mechanochemical synthesis of noble metal nanoparticles. Journal of Materials Chemistry A 8(32): 16114-16141.

DeGarmo, E.P., W.G. Sullivan, and J.R. Canada. 1984. Engineering Economy. 7th ed. Mac*mill*an, New York.

Deniaud-Bouët, E., N. Kervarec, G. Michel, T. Tonon, B. Kloareg, and C. Hervé. 2014. Chemical and enzymatic fractionation of cell walls from Fucales: Insights into the structure of the extracellular matrix of brown algae. Annals of Botany 114(6): 1203-1216.

Diharningrum, I.M. dan A. Husni. 2018. Metode ekstraksi jalur asam dan kalsium alginat berpengaruh pada mutu alginat rumput laut cokelat *Sargassum hystrix* J. Agardh. Jurnal Pengolahan Hasil Perikanan Indonesia 21(3): 532-542.

Din, N.A.S., A.S. Mohd Alayudin, N.-S. Sofian-Seng, H. Abdul Rahman, N.S. Mohd Razali, S.J. Lim, and W.A. Wan Mustapha. 2022. Brown algae as functional food source of fucoxanthin: A review. Foods 11(15): 2235.

Din, N.A.S., A.S. Mohd Alayudin, N.-S. Sofian-Seng, H. Abdul Rahman, N.S. Mohd Razali, S.J. Lim, and W.A. Wan Mustapha. 2022. Brown algae as functional food source of fucoxanthin: a review. Foods 11(15): 2235.

Ding, K., Hao, Z., Liang, X., Zhang, N., Zhang, H., Han, L., dan Xiao, W. 2025. Deciphering mechanochemical depolymerization of xylan hemicellulose: Dynamic structural evolution modulates xylo-oligosaccharide formation. *ACS Sustainable Chemistry & Engineering* 13(31): 12745–12755.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Dobrinčić, A., S. Balbino, Z. Zorić, S. Pedisić, D. Bursać Kovačević, I. Elez Garofulić, and V. Dragović-Uzelac. 2020. Advanced technologies for the extraction of marine brown algal polysaccharides. Marine Drugs 18(3): 168.

Duguma, H.T., L. Zhang, C.E. Ofoedu, J.S. Chacha, and A.O. Agunbiade. 2023. Potentials of superfine grinding in quality modification of food powders. CyTA-Journal of Food 21: 530-541.

E.M. Melchor-Martínez, and R. Parra-Saldivar. 2023. Polysaccharides from the *Sargassum* and brown algae genus: Extraction, purification, and their potential therapeutic applications. Plants 12(13): 2445.

Ealias, A.M. and M.P. Saravanakumar. 2017. A review on the classification, characterisation, synthesis of nanoparticles and their application. IOP Conference Series: Materials Science and Engineering 263(3): 032019.

Egodavitharana, D.I., S. Manikkrama, B.V.A.S.M. Bambaranda, and D.C. Mudannayake. 2024. Utilization of *Sargassum crassifolium* seaweed powder as a functional ingredient in wheat noodles. Journal of Applied Phycology 36(5): 2903-2915.

Ehsan, M., Razzaq, H., Razzaque, S., Bibi, A., dan Yaqub, A. 2022. Recent advances in sodium alginate-based membranes for dehydration of aqueous ethanol through pervaporation. *Journal of Polymer Science* 60(16): 2435–2453.

Elleuch, M., D. Bedigian, O. Roiseux, S. Besbes, C. Blecker, and H. Attia. 2011. Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. Food Chemistry 124(2): 411-421.

Etemadian, Y., Shabanpour, B., Ramzanpour, Z., *et al.* (2018). Evolution of *Sirophysalis trinodis* and *Polycladia myrica* water extract properties on corn snacks treated with them during 3 months of storage at ambient temperature. Journal of Food Processing and Preservation, e13579

Evaluation of the structural, physicochemical and functional properties of dietary fiber extracted from Newhall navel orange by-products. Foods 10(11): 2772.

Fellows, P. J. 2022. *Food Processing Technology: Principles and Practice*. Woodhead Publishing, Cambridge.

Feng, X., B. Yu, J.M. Regenstein, and L. Wang. 2023. Effect of particle size on composition, physicochemical, functional, and structural properties of insoluble dietary fiber concentrate from citrus peel. Food Science and Technology International 29(3): 195-203.

Flores-Contreras, E.A., R.G. Araújo, A.A. Rodríguez-Aguayo, M. Guzmán-Román, J.C. García-Venegas, E.F. Nájera-Martínez, J.E. Sosa-Hernández, H.M.N. Iqbal,

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Foerster, I., W. Seames, J. Oleksik, A. Kubatova, and A. Ross. 2023. A comprehensive study of techniques to optimize the extraction of lipids from the autotrophic strain of the microalgae *Chlorella vulgaris*. Life 13(10): 1997.

Food and Agriculture Organization of the United Nations (FAO). 2022. *Fishery and Aquaculture Statistics: Global Aquaculture Production 1950–2020 (FishStatJ)*. Food and Agriculture Organization of the United Nations, Rome.

Food and Drug Administration. 2014. Considering Whether an FDA-Regulated Product Involves the Application of Nanotechnology: Guidance for Industry. U.S. Department of Health and Human Services, Food and Drug Administration, Silver Spring, Maryland. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/considering-whether-fda-regulated-product-involves-application-nanotechnology. Diakses 15 Juli 2026.

Ford, L., Theodoridou, K., Sheldrake, G. N., dan Walsh, P. J. 2019. A critical review of analytical methods used for the chemical characterisation and quantification of phlorotannin compounds in brown seaweeds. *Phytochemical Analysis*.

Gan, L.-J., S. Chen, W. Chen, Y. Ye, L. Lei, Z. Deng, and H. Rong. 2023. Effect of particle size of *Sargassum fusiforme* residue powder on sugar-free cookies properties. LWT 182: 114826.

Gao, C., Xiao, W., Ji, G., Zhang, Y., Cao, Y., dan Han, L. 2017. Regularity and mechanism of wheat straw properties change in ball penggilingan process at cellular scale. *Bioresource Technology* 241: 214–219.

Gao, K., T. Liu, Q. Zhang, Y. Wang, X. Song, X. Luo, R. Ruan, L. Deng, X. Cui, and Y. Liu. 2024. Stabilization of emulsions prepared by *ball* penggilingan and cellulase treated pomelo peel insoluble dietary fiber: integrity of porous fiber structure dominates the stability. Food Chemistry 440: 138189.

Gao, P., X. Fan, D. Sun, G. Zeng, Q. Wang, and Q. Wang. 2024. Recent advances in *ball-mill*ed materials and their applications for adsorptive removal of aqueous pollutants. Water 16(12): 1639.

Gao, W., F. Chen, X. Wang, and Q. Meng. 2020. Recent advances in processing food powders by using superfine grinding techniques: A review. Comprehensive Reviews in Food Science and Food Safety 19(4): 2222-2255.

Generalić Mekinić, I., Šimat, V., Rathod, N. B., Hamed, I., dan Čagalj, M. 2023. Algal carotenoids: Chemistry, sources, and application. *Foods* 12(14): 2768.

Georgiou, D., Exarhopoulos, S., Charisis, A., Simitsis, S., Papapanagiotou, G., Samara, C. 2024. Valorization of *Monoraphidium* sp. microalgal biomass for human nutrition applications. *Journal of Applied Phycology* 36(3): 1293–1309.

Ghribi, A.M., I.M. Gafsi, C. Blecker, S. Danthine, H. Attia, and S. Besbes. 2015. Effect of drying methods on physico-chemical and functional properties of chickpea protein concentrates. Journal of Food Engineering 165: 179-188.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Ginting, R.F.B. dan A. Husni. 2020. Karakteristik flakes dengan fortifikasi tepung *Sargassum hystrix* sebagai pangan fungsional. Industria: Jurnal Teknologi dan Manajemen Agroindustri 9(3): 241-261.

Gómez-Ordóñez, E., A. Jiménez-Escrig, and P. Rupérez. 2010. Dietary fibre and physicochemical properties of several edible seaweeds from the northwestern Spanish coast. Food Research International 43(9): 2289-2294.

Gómez-Zavaglia, A., Barros, L., Prieto, M. A., dan Cassani, L. 2023. Recent progress in understanding the impact of food processing and storage on the structure–activity relationship of fucoxanthin. *Foods* 12(17): 3167.

Gómez-Zavaglia, A., Barros, L., Prieto, M. A., dan Cassani, L. 2023. Recent progress in understanding the impact of food processing and storage on the structure–activity relationship of fucoxanthin. *Foods* 12(17): 3167.

Gonçalves, R. F. S., *et al.* 2021. Nanoemulsions for enhancement of curcumin bioavailability and their safety evaluation: Effect of emulsifier type. Nanomaterials 11(3): 815.

Guiry, M.D. and G.M. Guiry. 2021. AlgaeBase: World-wide electronic publication, National University of Ireland, Galway. *Sargassum hystrix* J. Agardh 1847. https: //www.algaebase.org. Diakses 15 Juni 2026.

Gülçin, İ., and S.H. Alwasel. 2023. DPPH radical scavenging assay. Processes 11(8): 2248.

Guzzo, P.L., J.B. Santos, and R.C. David. 2014. Particle size distribution and structural changes in limestone ground in *planetary ball mill*. International Journal of Mineral Processing 126: 41-48.

H.T. Aung. 2020. Bioactivities, heavy metal contents and toxicity effect of macroalgae from two sites in Madura, Indonesia. Journal of the Saudi Society of Agricultural Sciences 19(8): 528 537.

Hammann, W., A. Ross, and W. Seames. 2024. Sequential extraction of carbohydrates and lipids from *Chlorella vulgaris* using combined physical and chemical pre-treatments. ChemEngineering 8(1): 11.

Han, N., J.-L. Fan, N. Chen, and H.-Q. Chen. 2022. Effect of *ball* penggilingan treatment on the structural, physicochemical and digestive properties of wheat starch, A- and B-type starch granules. Journal of Cereal Science 104: 103439.

Harish, V., M.M. Ansari, D. Tewari, M. Gaur, A.B. Yadav, M.-L. García-Betancourt, F.M. Abdel-Haleem, M. Bechelany, and A. Barhoum. 2022. Nanoparticle and nanostructure synthesis and controlled growth methods. Nanomaterials 12(18): 3226.

He, S., J. Li, Q. He, H. Jian, Y. Zhang, J. Wang, and H. Sun. 2018. Physicochemical and antioxidant properties of hard white winter wheat (*Triticum aestivm* L.) bran

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

superfine powder produced by eccentric vibratory penggilingan. Powder Technology 325: 126-133.

Hong, S.-J., P.R. Das, and J.-B. Eun. 2021. Effects of superfine grinding using *ball*-penggilingan on the physical properties, chemical composition, and antioxidant properties of *Quercus salicina* (Blume) leaf powders. Journal of the Science of Food and Agriculture 101(8): 3123-3131.

Huang, Y., Li, C., Zheng, S., Fu, X., Huang, Q., Liu, G., dan Chen, Q. 2024. Influence of three modification methods on the structure, physicochemical, and functional properties of insoluble dietary fiber from *Rosa roxburghii* Tratt pomace. *Molecules* 29(9): 2111.

Hulpa, W.L., N. Cokrowati, and N. Diniarti. 2021. Pertumbuhan rumput laut *Sargassum* sp. yang dibudidaya pada kedalaman berbeda di Teluk Ekas Lombok Timur. Jurnal Kelautan: Indonesian Journal of Marine Science and Technology 14(2): 185-191.

Husni, A., N. Izmi, F.Z. Ayunani, A. Kartini, N. Husnayain, and A. Isnansetyo. 2022. Characteristics and antioxidant activity of fucoidan from *Sargassum hystrix*: Effect of extraction method. International Journal of Food Science 2022: 3689724.

Husni, A., R. Lailatussifa, and A. Isnansetyo. 2019. *Sargassum hystrix* as a source of functional food to improve blood biochemistry profiles of rats under stress. Preventive Nutrition and Food Science 24(2): 150-158.

Igual, M. and J. Martínez-Monzó. 2022. Physicochemical properties and structure changes of food products during processing. Foods 11(15): 2365.

Iravani, S. and R.S. Varma. 2020. Green synthesis, biomedical and biotechnological applications of carbon and graphene quantum dots: An updated review. Materials Today 45: 206-240.

Ismail, M.M., G.M. El Zokm, and J.M. Miranda López. 2023. Nutritional, bioactive compounds content, and antioxidant activity of brown seaweeds from the Red Sea. Frontiers in Nutrition 10: 1210934.

Jacobsen, C., Sørensen, A.-D. M., Holdt, S. L., Akoh, C. C., dan Hermund, D. B. 2019. Source, extraction, characterization, and applications of novel antioxidants from seaweed. *Annual Review of Food Science and Technology* 10: 541–568.

Jacobsen, C., Sørensen, A.-D. M., Holdt, S. L., Akoh, C. C., dan Hermund, D. B. 2019. Source, extraction, characterization, and applications of novel antioxidants from seaweed. *Annual Review of Food Science and Technology* 10: 541–568.

Jakobek, L. and P. Matić. 2019. Non-covalent dietary fiber-polyphenol interactions and their influence on polyphenol bioaccessibility. Trends in Food Science & Technology 83: 235-247.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Jantasrirad, S., J. Mayakun, A. Numnuam, and K. Kaewtatip. 2021. Effect of filler and sonication time on the performance of brown alga (*Sargassum plagiophyllum*) filled cassava starch biocomposites. Algal Research 56: 102321.

Jiang, G., K. Ramachandraiah, Z. Wu, S. Li, and J.B. Eun. 2020. Impact of *ball*-penggilingan time on the physical properties, bioactive compounds, and structural characteristics of onion peel powder. Food Bioscience 36: 100630.

Jiang, Z., M. Zhang, Y. Huang, C. Ma, S. Mu, H. Li, X. Liu, Y. Ma, Y. Liu, and J. Hou. 2022. Comparison and characterization of the structure and physicochemical properties of three citrus fibers: Effect of *ball* penggilingan treatment. Foods 11(17): 2665.

Joy, J., A. Krishnamoorthy, A. Tanna, V. Kamathe, R. Nagar, and S. Srinivasan. 2022. Recent developments on the synthesis of nanocomposite materials via *ball* penggilingan approach for energy storage applications. Applied Sciences 12(18): 9312.

Kadian, R. 2018. Nanoparticles: A promising drug delivery approach. Asian J Pharm Clin Res 11(1): 30-5.

Kalepu, S. dan Nekkanti, V. 2016. Improved delivery of poorly soluble compounds using nanoparticle technology: A review. *Drug Delivery and Translational Research* 6(3): 319–332.

Ke, J., Wang, X., Gao, X., Zhou, Y., Wei, D., Ma, Y., Chen, Z. 2024. Ball penggilingan improves physicochemical, functionality, and emulsification characteristics of insoluble dietary fiber from *Polygonatum sibiricum*. *Foods* 13(15): 2323.

Ke, J., X. Wang, X. Gao, Y. Zhou, D. Wei, Y. Ma, C. Li, Y. Liu, and Z. Chen. 2024. *Ball* penggilingan improves physicochemical, functionality, and emulsification characteristics of insoluble dietary fiber from *Polygonatum sibiricum*. Foods 13(15): 2323.

Kementerian Kelautan dan Perikanan Republik Indonesia (KKP). 2024. *Statistik Produksi Perikanan Budidaya Menurut Komoditas Tahun 2021*. Kementerian Kelautan dan Perikanan Republik Indonesia, Jakarta.

Klojdová, I. dan Stathopoulos, C. 2022. The potential application of Pickering multiple emulsions in food. *Foods* 11(11): 1558.

Kuhn, S., J. Benavides, and M. Rodríguez. 2022. Cryogenic *ball* penggilingan for preservation of thermolabile compounds: Applications in food and pharmaceuticals. Trends in Food Science & Technology 120: 325-337.

Kumar, S., D. Sahoo, and I. Levine. 2015. Assessment of nutritional value in a brown seaweed *Sargassum wightii* and their seasonal variations. Algal Research 9: 117-125.

Kumari, T., Das, A. B., dan Deka, S. C. 2022. Impact of extraction methods on functional

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

properties and extraction kinetic of insoluble dietary fiber from green pea peels: A comparative analysis. *Journal of Food Processing and Preservation*: e16476.

Kumayanjati, B., P.S. Nugraheni, dan S.A. Budhiyanti. 2024. Pengaruh penggilingan menggunakan *planetary ball mill* terhadap struktur morfologi, kandungan proksimat dan foaming properties *Spirulina* bubuk. Jurnal Pascapanen dan Bioteknologi Kelautan dan Perikanan 19(2): 161-174.

Kwon, Y.-S., K.B. Gerasimov, and S.-K. Yoon. 2002. *Ball* temperatures during mechanical alloying in planetary *mill*s. Journal of Alloys and Compounds 346(1-2): 276-281.

Labanca, R.A., C. Svelander, and M. Alminger. 2019. Effect of particle size of chia seeds on bioaccessibility of phenolic compounds during in vitro digestion. Cogent Food & Agriculture 5(1): 1694775.

Lailatussifa, R., A. Husni, and A. Isnansetyo. 2017. Antioxidant activity and proximate analysis of dry powder from brown seaweed *Sargassum hystrix*. Jurnal Perikanan Universitas Gadjah Mada 19(1): 29-37.

Li, G., W. Guo, X. Gao, Y. Wang, and S. Sun. 2020. Effect of superfine grinding on physicochemical and antioxidant properties of soybean residue powder. Food Science & Nutrition 8(2): 1208-1214.

Li, S., J. Liu, Z.L. Wang, and D. Wei. 2025. Mechano-driven chemical reactions. Green Energy & Environment 10(5): 937-966.

Li, T., Z. Yin, and G. Wu. 2021. Study on heat transfer behavior and thermal breakage characteristic of the charge in *ball mill*s. Advances in Mechanical Engineering 13(3): 1-9.

Ling, Z., T. Wang, M. Makarem, M. Santiago Cintrón, H.N. Cheng, X. Kang, M. Bacher, A. Potthast, T. Rosenau, H. King, C.D. Delhom, S. Nam, J.V. Edwards,

Liu, X., Y. Liu, X. Du, B. Fu, P. Jiang, L. Qi, and S. Shang. 2024. Characterization of bamboo shoots dietary fiber modified by *ball* penggilingan and its role in altering the physicochemical properties of shrimp surimi. International Journal of Biological Macromolecules 271(Part 1): 131979.

Lomovskiy, I., Bychkov, A., Lomovsky, O., dan Skripkina, T. 2020. Mechanochemical and size reduction machines for biorefining. *Molecules* 25(22): 5345.

Lomovskiy, I., Bychkov, A., Lomovsky, O., dan Skripkina, T. 2020. Mechanochemical and size reduction machines for biorefining. *Molecules* 25(22): 5345.

Lozano Muñoz, I. dan Díaz, N. F. 2022. Minerals in edible seaweed: Health benefits and food safety issues. *Critical Reviews in Food Science and Nutrition* 62(6): 1592–1607.

Lozano Muñoz, I. dan Díaz, N. F. 2022. Minerals in edible seaweed: Health benefits and

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

food safety issues. *Critical Reviews in Food Science and Nutrition* 62(6): 1592–1607.

Lunardi, C. N., Gomes, A. J., Rocha, F. S., De Tommaso, J., dan Patience, G. S. 2021. Experimental methods in chemical engineering: Zeta potential. *The Canadian Journal of Chemical Engineering* 99(3): 627–639.

Lutfiawan, M., Karnan, dan L. Japa. 2015. Analisis pertumbuhan *Sargassum sp.* dengan sistem budidaya yang berbeda di Teluk Ekas Lombok Timur sebagai bahan pengayaan mata kuliah ekologi tumbuhan. Jurnal Biologi Tropis 15(2): 135-144.

M. Danila, A.F. Bucur, and M. Hancianu. 2023. Current overview of metal nanoparticles' synthesis, characterization, and biomedical applications, with a focus on silver and gold nanoparticles. Pharmaceuticals 16(10): 1410.

M. Katsiapi, G. Kountrias, S. Bouras, N. Katsoulas, I.T. Karapanagiotidis, C. Chatzidoukas, and E.P. Kalogianni. 2024. Valorization of *Monoraphidium sp.* microalgal biomass for human nutrition applications. Journal of Applied Phycology 36: 1293-1309.

M.I. Ahmad, I.S. Md Yasin, A. Isha, and M. Aliyu-Paiko. 2021. Chemical, nutrient and physicochemical properties of brown seaweed, *Sargassum polycystum* C. Agardh (Phaeophyceae) collected from Port Dickson, Peninsular Malaysia. Molecules 26(17): 5216.

Martelli, S. dan Di Nunzio, P. E. 2025. Powder ball penggilingan: An energy balance approach to particle size reduction. *Journal of Materials Research* 40(2): 292–308.

Masoud, M.S., S.M. Amin, and M.S. Abdel-Kareem. 2024. Bioremediation of iron from polluted water using marine algae. International Journal of Environmental Science and Technology 21: 5681-5690.

Matsanga, N., W. Nheta, and N. Chimwani. 2023. A review of the grinding media in *ball mill*s for mineral processing. Minerals 13(11): 1373.

Mayer-Laigle, C., Blanc, N., Rajaonarivony, R. K., dan Rouau, X. 2018. Comminution of dry lignocellulosic biomass, a review: Part I—From fundamental mechanisms to penggilingan behaviour. *Bioengineering* 5(2): 41.

McCleary, B.V. 2023. Measurement of dietary fiber: Which AOAC Official Method of Analysis to use. Journal of AOAC International 106(4): 917-930.

McClements, D. J., dan H. Xiao. 2017. Is nano safe in foods? Establishing the factors impacting the gastrointestinal fate and toxicity of organic and inorganic food-grade nanoparticles. npj Science of Food 1: 6.

Meng, W., T. Mu, H. Sun, and M. Garcia-Vaquero. 2022. Evaluation of the chemical composition and nutritional potential of brown macroalgae commercialised in China. Algal Research 64: 102683.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Michel, G., T. Tonon, D. Scornet, J.M. Cock, and B. Kloareg. 2010. The cell wall polysaccharide metabolism of the brown alga *Ectocarpus siliculosus*: Insights into the evolution of extracellular matrix polysaccharides in eukaryotes. New Phytologist 188(1): 82-97.

Mishra, K., H. Ojha, and N.K. Chaudhury. 2012. Estimation of antiradical properties of antioxidants using DPPH assay: A critical review and results. Food Chemistry 130(4): 1036-1043.

Mitchell, M. J., M. M. Billingsley, R. M. Haley, M. E. Wechsler, N. A. Peppas, dan R. Langer. 2021. Engineering precision nanoparticles for drug delivery. Nature Reviews Drug Discovery 20(2): 101–124.

Mohamed, A.A., M.Y. Sameeh, and H.S. El-Beltagi. 2023. Preparation of seaweed nanopowder particles using planetary *ball* penggilingan and their effects on some secondary metabolites in date palm (*Phoenix dactylifera* L.) seedlings. Life 13(1): 39.

Mousavi Khaneghah, A., S.M.B. Hashemi, and S. Limbo. 2018. Nanoparticles in food science: Functions, applications, and safety concerns. Trends in Food Science & Technology 75: 17-24.

Munteanu, I. G. dan Apetrei, C. 2021. Analytical methods used in determining antioxidant activity: A review. *International Journal of Molecular Sciences* 22(7): 3380.

Narra, F., Piragine, E., Benedetti, G., Ceccanti, C., Florio, M., Spezzini, J., dan Guidi, L. 2024. Impact of thermal processing on polyphenols, carotenoids, glucosinolates, and ascorbic acid in fruit and vegetables and their cardiovascular benefits. *Comprehensive Reviews in Food Science and Food Safety* 23(6): e13426.

Naw, S. W., Zaw, N. D. K., Aminah, N. S., Alamsjah, M. A., Kristanti, A. N., Nege, A. S., dan Aung, H. T. 2020. Bioactivities, heavy metal contents and toxicity effect of macroalgae from two sites in Madura, Indonesia. *Journal of the Saudi Society of Agricultural Sciences* 19(8): 528–537.

Nazarudin, M. F., Alias, N. H., Balakrishnan, S., Wan Hasnan, W. N. I., Noor Mazli, N. A. I., Ahmad, M. I., Md Yasin, I. S., Isha, A., dan Aliyu-Paiko, M. 2021. Chemical, nutrient and physicochemical properties of brown seaweed, *Sargassum polycystum* C. Agardh (Phaeophyceae) collected from Port Dickson, Peninsular Malaysia. *Molecules* **26**(17): 5216.

Negrescu, A.M., M.S. Killian, S.N.V. Raghu, P. Schmuki, A. Mazare, and A. Cimpean. 2022. Metal oxide nanoparticles: review of synthesis, characterization and biological effects. Journal of Functional Biomaterials 13(4): 274.

Németh, Z., I. Csóka, R. Semnani Jazani, B. Sipos, H. Haspel, G. Kozma, Z. Kónya, and D.G. Dobó. 2022. Quality by design-driven zeta potential optimisation study of liposomes with charge imparting membrane additives. Pharmaceutics 14(9): 1798.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Noyanti, R., M.S.J. Sofiana, dan W. Warsidah. 2023. Analisis kandungan nutrisi, mineral esensial dan uji fitokimia *Sargassum sp.* asal Perairan Pulau Temajo, Kabupaten Mempawah. Jurnal Laut Khatulistiwa 6(2): 85-89.

Paga, A., A. Agus, Kustantinah, and I.G.S. Budisatria. 2021. Effect of different drying methods on the mineral content of seaweed *Sargassum sp.* Livestock Research for Rural Development 33(3): 35.

Pang, J., E. Guan, Y. Yang, M. Li, and K. Bian. 2021. Effects of wheat flour particle size on flour physicochemical properties and steamed bread quality. Food Science & Nutrition 9(9): 4691-4700.

Patra, J. K., *et al.* 2018. Nano based drug delivery systems: Recent developments and future prospects. Journal of Nanobiotechnology 16: 71.

Patra, J.K., G. Das, L.F. Fraceto, E.V.R. Campos, M.D.P. Rodriguez-Torres, L.S. Acosta-Torres, L.A. Diaz-Torres, R. Grillo, M.K. Swamy, S. Sharma, S. Habtemariam, and H.-S. Shin. 2018. Nano based drug delivery systems: Recent developments and future prospects. Journal of Nanobiotechnology 16(1): 71.

Peñalver, R., J.M. Lorenzo, G. Ros, R. Amarowicz, M. Pateiro, and G. Nieto. 2020. Seaweeds as a functional ingredient for a healthy diet. Marine Drugs 18(6): 301.

Peng, Z., Y. Wu, Q. Fu, and J. Xiao. 2024. Free and bound phenolic profiles and antioxidant ability of eleven marine macroalgae from the South China Sea. Frontiers in Nutrition 11: 1459757.

Pochapski, D.J., C.C. dos Santos, G.W. Leite, S.H. Pulcinelli, and C.V. Santilli. 2021. Zeta potential and colloidal stability predictions for inorganic nanoparticle dispersions: Effects of experimental conditions and electrokinetic models on the interpretation of results. Langmuir 37(45): 13379-13389.

Pournaki, S.K., R. Santos Aleman, M. Hasani-Azhdari, J. Marcia, A. Yadav, and M. Moncada. 2024. Current review: Alginate in the food applications. J 7(3): 281-301.

Prabha, S., R. Singh, and R. Vatsa. 2021. Nanoparticles in food and agriculture: Applications and future outlook. Environmental Chemistry Letters 19(2): 641-658.

Prabhasankar, P., P. Ganesan, and N. Bhaskar. 2009. Influence of Indian brown seaweed (*Sargassum marginatum*) as an ingredient on quality, biofunctional, and microstructure characteristics of pasta. Food Science and Technology International 15(5): 471-479.

Pradhan, B., Nayak, R., Bhuyan, P. P., Patra, S., Behera, C. 2022. Algal phlorotannins as novel antibacterial agents with reference to the antioxidant modulation: Current advances and future directions. *Marine Drugs* 20(6): 403.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Prasad, R., A. Bhattacharyya, and Q.D. Nguyen. 2017. Nanotechnology in sustainable agriculture: Recent developments, challenges, and perspectives. Frontiers in Microbiology 8: 1014.

Prasedya, E.S., A. Frediansyah, N.W.R. Martyasari, B.K. Ilhami, A.S. Abidin, H. Padmi, Fahrurrozi, A.B. Juanssilfero, S. Widyastuti, and A.L. Sunarwidhi. 2021. Effect of particle size on phytochemical composition and antioxidant properties of *Sargassum cristaefolium* ethanol extract. Scientific Reports 11: 17876.

Prasetyaningsih, A., L.H. Nugroho, E.B.E. Kristiani, S. Hutomo, and G. Sasongko. 2024. Distribution pattern of *Sargassum spp.* on the south coast of Gunungkidul Regency, Special Region of Yogyakarta, Indonesia using satellite imagery. Egyptian Journal of Aquatic Biology and Fisheries 28: 1821-1845.

Pratiwi, D.R. and A. Husni. 2021. The impact of immersion time in lime solution on antioxidant and antidiabetic properties and consumer evaluation of *Sargassum hystrix* seaweed tea. AACL Bioflux 14(4): 2354-2366.

Radmilović-Radjenović, M., D. Radjenović, and B. Radjenović. 2021. The effect of grinding on the apparent color of the yellow sugar powder. Optoelectronics and Advanced Materials - Rapid Communications 15(3-4): 164-168.

Ramachandraiah, K. and K.B. Chin. 2016. Evaluation of *ball*-penggilingan time on the physicochemical and antioxidant properties of persimmon by-products powder. Innovative Food Science & Emerging Technologies 37: 115-124.

Ramachandraiah, K. dan Chin, K. B. 2017. Impact of drying and micronization on the physicochemical properties and antioxidant activities of celery stalk. *Journal of the Science of Food and Agriculture* 97(13): 4539–4547.

Reißner, A.-M., M. Brunner, S. Struck, and H. Rohm. 2022. Thermo-mechanical processing of fibre-rich blackcurrant pomace to modify techno-functional properties. European Food Research and Technology 248: 2359-2368.

Remya, R.R., A.V. Samrot, S.S. Kumar, V. Mohanavel, A. Karthick, V.K. Chinnaiyan, D. Umapathy, and M. Muhibbullah. 2022. Bioactive potential of brown algae. Adsorption Science & Technology 2022: 1-13.

Rhodes, M. 2008. Introduction to Particle Technology. 2nd ed. John Wiley & Sons, Chichester.

Riquelme, N., P. Robert, dan C. Arancibia. 2024. Desserts enriched with a nanoemulsion loaded with vitamin D3 and omega-3 fatty acids for older people. Foods 13(13): 2073.

Robertson, J.A., F.D. de Monredon, P. Dysseler, F. Guillon, R. Amado, and J.-F. Thibault. 2000. Hydration properties of dietary fibre and resistant starch: A European collaborative study. LWT-Food Science and Technology 33(2): 72-79.

Rodríguez-Loya, J., Lerma, M., dan Gardea-Torresdey, J. L. 2024. Dynamic light

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

scattering and its application to control nanoparticle aggregation in colloidal systems: A review. *Micromachines* 15(1): 24.

Rosland Abel, S.E., Y.A. Yusof, N.L. Chin, L.S. Chang, H. Mohd Ghazali, and Y.N.A. Manaf. 2020. Characterisation of physicochemical properties of gum arabic powder at various particle sizes. Food Research 4(Suppl. 1): 107-115.

Rudayni, H.A., A.M. Rabie, M. Aladwani, L.M. Alneghery, G.M. Abu-Taweel, W. Al Zoubi, A.A. Allam, M.R. Abukhadra, and S. Bellucci. 2023. Biological activities of *Sargassum* algae mediated ZnO and Co doped ZnO nanoparticles as enhanced antioxidant and anti-diabetic agents. Molecules 28(9): 3692.

Ruíz Suarez, C. B., Schalchli Sáez, H. L., Melo, P. S., Moreira, C. D. S., Sartori, A. G. D. O., de Alencar, S. M., dan Scheuermann Salinas, E. S. 2024. Effect of physical separation with ultrasound application on brewers' spent grain to obtain powders for potential application in foodstuffs. *Foods* 13(18): 3000.

S. Marno, Y. Asri, S. Dwiyanti, S.Y. Lumbessy, W. Latifah, and R.A. Fikri. 2024. The distribution, habitat characteristics, and bioenergy potential of *Sargassum sp.* in Indonesia. International Journal of Design & Nature and Ecodynamics 19(6): 2049-2062.

S.A. Heleno. 2023. Powdered foods: Structure, processing, and challenges: A review. Applied Sciences 13(22): 12496.

S.H. Kim, F. Xu, and A.D. French. 2019. Effects of *ball* penggilingan on the structure of cotton cellulose. Cellulose 26(1): 305-328.

Sai Gopal, K.N., S.R. Nalodae, N. Singh, T.S.C. Teja, M.L. Akash, and V. Saini. 2024. Recent advancements in magnetic nanoparticles for cancer and therapeutic treatments. AIP Conference Proceedings 2986(1): 030148. AIP Publishing LLC.

Sakinah, N. dan F. Ayustaningwarno. 2013. Pengaruh substitusi tepung terigu dengan tepung rumput laut *Sargassum sp.* terhadap kandungan zat gizi dan kesukaan MP-ASI biskuit kaya zat besi. Journal of Nutrition College 2(1): 154-161.

Sakr, H., A. Ammar, H. Zaki, M.A. Salama, and M. Ali. 2024. Impact of *ball* penggilingan on physicochemical, structural, and functional properties of *Moringa oleifera* L. leaf powders. Journal of Food Measurement and Characterization 18: 320-330.

Salmeán, A.A., D. Duffieux, J. Harholt, F. Qin, G. Michel, M. Czjzek, W.G.T. Willats, and C. Hervé. 2017. Insoluble (1→3), (1→4)-β-D-glucan is a component of cell walls in brown algae (Phaeophyceae) and is masked by alginates in tissues. Scientific Reports 7: 2880.

Salosso, Y. 2019. Nutrient and alginate content of macroalgae *Sargassum sp.* from Kupang Bay waters, East Nusa Tenggara, Indonesia. AACL Bioflux 12(6): 2130-2136.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Sang, J., L. Li, J. Wen, Q. Gu, J. Wu, Y. Yu, Y. Xu, M. Fu, and X. Lin. 2021.

Saraswati, P.E. Giriwono, D. Iskandriati, C.P. Tan, and N. Andarwulan. 2019. *Sargassum* seaweed as a source of anti-inflammatory substances and the potential insight of the tropical species: A review. Marine Drugs 17(10): 590.

Schmidt, R., H. Martin Scholze, and A. Stolle. 2016. Temperature progression in a mixer *ball mill*. International Journal of Industrial Chemistry 7: 181-186.

Schmidt, R., Scholze, H. M., dan Stolle, A. 2016. Temperature progression in a mixer ball mill. *International Journal of Industrial Chemistry* 7(2): 181–186.

Sedjati, S., E. Supriyantini, A. Ridlo, N. Soenardjo, dan V.Y. Santi. 2018. Kandungan pigmen, total fenolik dan aktivitas antioksidan *Sargassum sp.* Jurnal Kelautan Tropis 21(2): 137-144.

Setiyawan, A. and A. Husni. 2022. Antioxidant, antidiabetic activities and consumer acceptance of *Sargassum hystrix* tea combined with cinnamon powder. Food Research 6(2): 159-165.

Singh, C.B., K.A.M. Xavier, and G. Deshmukhe. 2018. Fortification of extruded product with brown seaweed (*Sargassum tenerrimum*) and its process optimization by response surface methodology. Waste and Biomass Valorization 9(5): 755-764.

Sinurat, E. and T.D. Suryaningrum. 2019. The effect of blanching time on antioxidant activity and sensory characteristic of brown seaweed *Sargassum sp.* tea. Jurnal Pengolahan Hasil Perikanan Indonesia 22(3): 581-588.

Štefanić, G., S. Krehula, and I. Štefanić. 2015. Phase development during high-energy *ball*-penggilingan of zinc oxide and iron - the impact of grain size on the source and the degree of contamination. Dalton Transactions 44(43): 18870-18881.

Stiger-Pouvreau, V., L. Mattio, A. De Ramon N'Yeurth, S. Uwai, H. Dominguez, N. Flórez-Fernández, S. Connan, and A.T. Critchley. 2023. A concise review of the highly diverse genus *Sargassum* C. Agardh with wide industrial potential. Journal of Applied Phycology 35(4): 1453-1483.

Su, W., W. Xu, and W. Su. 2023. One-pot, water-based disruption of cell walls and astaxanthin extraction from *Haematococcus pluvialis* by mechanochemistry. ACS Sustainable Chemistry & Engineering 11: 5023-5031.

Suhaila, K., A. Husni, and E. Sinurat. 2019. Characteristics and antioxidant activity of fucoidan from the brown seaweed *Sargassum hystrix*. AACL Bioflux 12(6): 2319-2329.

Sulistiyani, Y., A. Sabdono, N. Afiati, and Haeruddin. 2021. Fucoxanthin identification and purification of brown algae commonly found in Lombok Island, Indonesia. Biodiversitas 22(3): 1527-1534.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Sumarni, T.N., W. Warsidah, I. Safitri, A.A. Kushadiwijayanto, dan M.S.J. Sofiana. 2022. Analisis kandungan proksimat dan mineral zink dari *Sargassum sp.* asal Perairan Pulau Kabung. Oseanologia 1(1): 24-27.

Suryanarayana, C. 2019. Mechanical alloying and penggilingan. Progress in Materials Science 46(1-2): 1-184.

Tagliapietra, B.L., R. Salvador-Reyes, C.C. Pinto, S.M. de Souza, J.A.L. Pallone, J. de Araújo Bezerra, J. Moreira Mar, E.A. Sanches, and M.T.P.S. Clerici. 2024. Nutritional and techno-functional properties of the brown seaweed *Sargassum filipendula*. Food Research International 191: 114728.

Takamasa, A. and S. Nakai. 2009. Contamination introduced during rock sample powdering: effects from different *mill* materials on trace element contamination. Geochemical Journal 43(5): 389-394.

Tang, Y. R. dan Ghosh, S. 2023. A review of the utilization of canola protein as an emulsifier in the development of food emulsions. *Molecules* 28(24): 8086.

Tavares, L.M. 2022. Review and further validation of a practical single-particle breakage model. KONA Powder and Particle Journal 39: 62-83.

Thakur, S. dan Arotiba, O. A. 2018. Synthesis, swelling and adsorption studies of a pH-responsive sodium alginate–poly(acrylic acid) superabsorbent hydrogel. *Polymer Bulletin* 75(10): 4587–4606.

Thiurunavukkarau, R., S. Shanmugam, K. Subramanian, P. Pandi, G. Muralitharan, M. Arokiarajan, K. Kasinathan, A. Sivaraj, R. Kalyanasundaram, S.Y. AlOmar, and V. Shanmugam. 2022. Silver nanoparticles synthesized from the seaweed *Sargassum* polycystum and screening for their biological potential. Scientific Reports 12: 14757.

Thommes, M., Kaneko, K., Neimark, A. V., Olivier, J. P., Rodriguez-Reinoso, F., Rouquerol, J., dan Sing, K. S. W. 2015. Physisorption of gases, with special reference to the evaluation of surface area and pore size distribution (IUPAC Technical Report). *Pure and Applied Chemistry* 87(9–10): 1051–1069.

Ueda, J. M., Morales, P., Fernández-Ruiz, V., Ferreira, A., Barros, L., Carocho, M., dan Ferreira, I. C. F. R. 2023. Powdered foods: Structure, processing, and challenges: A review. *Applied Sciences* 13(22): 12496.

Uhlemann, J., Diedam, H., Hoheisel, W., Schikarski, T., dan Peukert, W. 2020. Modeling and simulation of process technology for nanoparticulate drug formulations—A particle technology perspective. *Pharmaceutics* 13(1): 22.

Vaidya, A. A., Donaldson, L. A., Newman, R. H., Suckling, I. D., Campion, S. H., Lloyd, J. A., dan Murton, K. D. 2016. Micromorphological changes and mechanism associated with wet ball penggilingan of *Pinus radiata* substrate and consequences for saccharification at low enzyme loading. *Bioresource Technology* 214: 132–137.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Viczek, S.A., K. Khodier, L. Kandlbauer, A. Aldrian, G. Redhammer, G. Tippelt, and R. Sarc. 2021. The particle size-dependent distribution of chemical elements in mixed commercial waste and implications for enhancing SRF quality. Science of the Total Environment 776: 145343.

Viera, I., Pérez-Gálvez, A., dan Roca, M. 2019. Green natural colorants. *Molecules* 24(1): 154.

Wang, J., M. Zhang, S. Devahastin, and Y. Liu. 2020. Influence of low-temperature *ball* penggilingan time on physicochemical properties, flavor, bioactive compounds contents and antioxidant activity of horseradish powder. Advanced Powder Technology 31(3): 914-921.

Wessels, I., Maywald, M., dan Rink, L. 2017. Zinc as a gatekeeper of immune function. *Nutrients* 9(12): 1286.

Widyartini, D.S., A.I. Insan, and Sulistyani. 2017. Thallus variation of *Sargassum polycystum* from Central Java, Indonesia. Biodiversitas 18(3): 1004-1011.

Wong, K.H. and P.C.K. Cheung. 2001. Influence of drying treatment on three *Sargassum* species: 1. Proximate composition, amino acid profile and some physico-chemical properties. Journal of Applied Phycology 13(1): 43-50.

Wong, S. K., Low, L. E., Supramaniam, J., Manickam, S., Wong, T. W., Pang, C. H., dan Tang, S. Y. 2021. Physical stability and rheological behavior of Pickering emulsions stabilized by protein–polysaccharide hybrid nanoconjugates. *Nanotechnology Reviews* 10(1): 1293–1305.

Wouthuyzen, S., S.M.C. Herandarudewi, and T. Komatsu. 2016. Stock assessment of brown seaweeds (Phaeophyceae) along the Bitung-Bentena coast, North Sulawesi Province, Indonesia for alginate product using satellite remote sensing. Procedia Environmental Sciences 33: 553-561.

Wu, Y., H. Gao, Y. Wang, Z. Peng, Z. Guo, Y. Ma, R. Zhang, M. Zhang, Q. Wu, J. Xiao, and Q. Zhong. 2022. Effects of different extraction methods on contents, profiles, and antioxidant abilities of free and bound phenolics of *Sargassum* polycystum from the South China Sea. Journal of Food Science 87(3): 968-981.

Wu, Z., Ameer, K., dan Jiang, G. 2021. Effects of superfine grinding on the physicochemical properties and antioxidant activities of Sanchi (*Panax notoginseng*) flower powders. *Journal of Food Science and Technology* 58(1): 62–73.

Xiao, Z., X. Yang, W. Zhao, Z. Wang, and Q. Ge. 2022. Physicochemical properties of insoluble dietary fiber from pomelo (Citrus grandis) peel modified by *ball* penggilingan. Journal of Food Processing and Preservation 46(2): e16242.

Xu, M., S. Sakamoto, and T. Komatsu. 2016. Attachment strength of the subtidal seaweed *Sargassum horneri* (Turner) C. Agardh varies among development stages and depths. Journal of Applied Phycology 28: 3679-3687.

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Yang, J., Y. Ren, B. Xie, C. Wan, S. Xin, and K. Song. 2026. Superfine grinding for edible powders: Mechanisms, quality regulation, limitations, and synergistic strategies. Foods 15(12): 2050.

Yang, K., J. Yao, K. Shi, C. Yang, Y. Xu, P. Zhang, and S. Pan. 2024. Emulsification characteristics of insoluble dietary fibers from pomelo peel: effects of acetylation, enzymatic hydrolysis, and wet *ball* penggilingan. Foods 13(4): 624.

Ye, S., C. Xie, O.T. Agar, C.J. Barrow, F.R. Dunshea, and H.A.R. Suleria. 2024. Alginates from brown seaweeds as a promising natural source: A review of its properties and health benefits. Food Reviews International 40: 2682-2710.

Yntema, F., C. Webster, and E. Broumidis. 2025. A new *planetary ball mill* device with adjustable speed ratio for enhanced mechanochemical processes. RSC Mechanochemistry 2(1): 20-24.

Yu, S., J. Liu, L. Li, G. Zheng, X. Han, S. Chen, and Y. Zhang. 2023. Effect of different penggilingan methods on physicochemical and functional properties of mung bean flour. Frontiers in Nutrition 10: 1117385.

Zhang, F.L., M. Zhu, and C.Y. Wang. 2008. Parameters optimization in the planetary *ball* penggilingan of nanostructured tungsten carbide/cobalt powder. International Journal of Refractory Metals and Hard Materials 26(4): 329-333.

Zhang, K., Huang, J., Wang, D., Wan, X., dan Wang, Y. 2024. Covalent polyphenols–proteins interactions in food processing: Formation mechanisms, quantification methods, bioactive effects, and applications. *Frontiers in Nutrition* 11: 1371401.

Zhang, L., Y. Jia, H. He, J. Yin, R. Chen, C. Zhang, W. Shen, and X. Wang. 2018. Multiple factor analysis on preparation of cellulose nanofiber by *ball* penggilingan from softwood pulp. BioResources 13(2): 2397-2410.

Zhang, S., Dong, J., Pan, R., Xu, Z., Li, M., dan Zang, R. 2023. Structures, properties, and bioengineering applications of alginates and hyaluronic acid. *Polymers* 15(9): 2149.

Zhang, S., Dong, J., Pan,R., Xu, Z., Li, M., dan Zang, R. 2023. Structures, properties, and bioengineering applications of alginates and hyaluronic acid. *Polymers* 15(9): 2149.

Zhang, X., Wang, D., Liu, S., dan Tang, J. 2022. Bacterial cellulose nanofibril-based Pickering emulsions: Recent trends and applications in the food industry. *Foods* 11(24): 4064.

Zhang, Z., W. Shen, and Y. Xie. 2023. Shape and size effects of nanomaterials in biomedical applications. Journal of Materials Chemistry B 11(7): 1387-1404.

Zhao, D., S.-M. Kim, C.-H. Pan, and D. Chung. 2014. Effects of heating, aerial exposure and illumination on stability of fucoxanthin in canola oil. Food Chemistry 145: 505-513

UNIVERSITAS
GADJAH MADA
Pengaruh Durasi Penggilingan terhadap Karakteristik Fisikokimia Bubuk Sargassum hystrix yang Dipreparasi dengan Metode Top-Down menggunakan Planetary Ball Mill
Ahmad Sukma Luhur, Dr. R.A. Siti Ari Budhiyanti, S.T.P., M.P.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

Zhao, H., Xiao, W., Liu, D., Zhao, W., Zhou, K., Hou, L., Ma, X. 2025. Formation mechanism and influencing factors of micro-nano dual-size NiPd alloy with a flake-like microstructure. *Materials* 18(4): 829.

Zheng, H., Y. Sun, T. Zheng, Y. Zeng, L. Fu, T. Zhou, F. Jia, Y. Xu, K. He, and Y. Yang. 2023. Effects of shear emulsifying/*ball* penggilingan/autoclave modification on structure, physicochemical properties, phenolic compounds, and antioxidant capacity of lotus (Nelumbo) leaves dietary fiber. Frontiers in Nutrition 10: 1064662.

Zhou, Y., G. Liu, T. Zhou, and S. Ni. 2025. Optimization of the *ball* penggilingan process for producing superfine green tea powder: An analytic hierarchy process-fuzzy comprehensive evaluation approach. Foods 14(7): 1283.

Zhu, K.X., S. Huang, W. Peng, H.F. Qian, and H.M. Zhou. 2010. Effect of ultrafine grinding on hydration and antioxidant properties of wheat bran dietary fiber. Food Research International 43(4): 943-948.