

DAFTAR PUSTAKA

- Alharthi, A. S., H. H. Al-Baadani, and A. A. Alghonaim. 2024. Effects of *Spirulina platensis* addition on performance, immune response, hematological, selected bacteria activity and rumen morphology of lambs. *Italian Journal of Animal Science*. 23(1): 1134–1145.
- Andrio, D., M. Syafila, M. Handajani, dan D. Natalia. 2015. Pengaruh pengendalian pH terhadap pembentukan etanol dan pergeseran produk asidogenesis dari fermentasi limbah cair industri minyak sawit. *Jurnal Manusia dan Lingkungan* 22(1): 1–11.
- Beauchemin K.A., M. Kreuzer, F. O'Mara, T.A. Mc Allister. 2008. Nutritional management for enteric methane abatement: A review, *Australian Journal of Experimental Agriculture*. 48(2): 21-27.
- Burhanuddin, Akmaluddin, S. Soadiq, A. Haris, A. Malik, M. Iqbal, dan M.S. Saleh. 2022. Pemanfaatan ampas kelapa hasil fermentasi cairan rumen dalam pakan buatan terhadap pertumbuhan dan sintasan ikan nila *Oreochromis niloticus*. *Jurnal Ilmiah Ecosystem* 22(3): 448-455.
- Castillo-González, A.R., M.E. Burrola-Barraza, J. Domínguez-Viveros, and A. Chávez-Martínez. 2014. Rumen microorganisms and fermentation. *Arch Med Vet* 46: 349–361.
- Christine, Y., R. M. Br Karo, E. Neswita, dan C. Tanamal. 2024. Penentuan kadar total flavonoid dari fraksi etil asetat ekstrak metanol daun kerai payung (*Filicium decipiens*). *Jambura Journal of Health Science and Research* 6(3): 319–326.
- Cone, J.W., and P.M. Becker. 2012. Fermentation kinetics and production of volatile fatty acids and microbial protein by starchy feedstuffs. *Anim Feed Sci Technol* 172: 34–41.
- Costa, D. F. A., J. M. Castro-Montoya, K. Harper, dan L. Trevaskis. 2022. Algae as feedstuff for ruminants: A focus on single-cell species, opportunistic use of algal by-products and on-site production. *Microorganisms* 10: 2313.
- Dai, D., C. Dong, F. Kong, S. Wang, S. Wang, W. Wang, dan S. Li. 2025. Dietary supplementation of *Scutellariae radix* flavonoid extract improves lactation performance in dairy cows by regulating gastrointestinal microbes, antioxidant capacity and immune function. *Animal Nutrition* 20: 499-508.
- Dehority, B.A. 2004. *Rumen Microbiology*. Nottingham University Press. Nottingham.
- Dubois B., N. Tomkins, R.D. Kinley, M. Bai, S. Seymour, N.A. Paul, R. Nys. 2013. Effect of tropical algae as additives on rumen *in vitro* gas production and fermentation characteristics. *Am. J. Plant Science*. 4(12): 34–43.
- Finamore, A., M. Palmery, S. Bensehaila, dan I. Peluso. 2017. Antioxidant, immunomodulating, and microbial-modulating activities of the sustainable and ecofriendly *Spirulina*. *Oxidative Medicine and Cellular Longevity* 2017: 1–14.

- France, J. dan Dijkstra, J. 2005. Volatile Fatty Acid Productions. In: Quantitative Aspect of Ruminant Digestion and Metabolism. 2nd Ed. CAB. International, Cambridge, USA.
- Han K.J. Mc Cormick M.E. 2014. Evaluation of nutritive value and *in vitro* rumen fermentation gas accumulation of de-oiled algal residues. J. Anim. Sci. Biotechnol. 5: 31.
- Haq, M., S. Fitra, S. Madusari, dan D.I. Yama. 2018. Potensi kandungan nutrisi pakan berbasis limbah pelepah kelapa sawit dengan Teknik fermentasi. Seminar Nasional Sains dan Teknologi Fakultas Teknik. Universitas Muhammadiyah Jakarta.
- Hassan, F., M. A. Arshad, M. Li, M. S. Rehman, J. J. Loor, dan J. Huang. 2020. Potential of Mulberry Leaf Biomass and Its Flavonoids to Improve Production and Health in Ruminants: Mechanistic Insights and Prospects. Animals 10: 2076.
- Hastuti, D., N. A. Shofia, dan I. M. Baginda. 2011. Pengaruh perlakuan teknologi amofer (amoniasi fermentasi) pada limbah tongkol jagung sebagai alternatif pakan berkualitas ternak ruminansia. Jurnal Ilmu Pertanian 7 (1): 55-65
- Hidayah, N. 2016. Pemanfaatan senyawa metabolit sekunder tanaman (tanin dan saponin) dalam mengurangi emisi metan ternak ruminansia. Jurnal Sain Peternakan Indonesia 11(2): 89–98.
- Holman, B., A. Malau-Aduli. 2013. *Spirulina* as a Livestock Supplement and Animal Feed. J. Anim. Physiol. Anim. Nutr. 97: 615–623
- Hosen, Z., M. R. Islam, R. Naidu, and B. Biswas. 2025. Geophagy and Clay Minerals: Influencing Ruminal Microbial Fermentation for Methane Mitigation. Microorganisms 13(4): 866.
- Hoy, C.P.E., E. Hartati, dan G.A.Y. Lestari. 2023. Pengaruh silase pakan komplit berbasis sorgum *Clitoria ternatea* dengan penambahan berbagai level konsentrat mengandung ZnSO₄ dan ZnCu isoleusinat terhadap fermentasi rumen *in vitro*. Animal Agricultura 1(2): 79-89.
- Indrayani, H. Hafid, dan D. Agustiana. 2015. Kecernaan *in vitro* silase sampah sayur dan daun gamal menggunakan mikrobial rumen kambing. Jurnal Ilmu dan Teknologi Peternakan Tropis 2(3): 17-24.
- Jessop, N. S. And M. Nerrero. 1996. Influence of Soluble Components on Parameter estimation using the *in vitro* gas production technique. J. Anim Sci. 62: 621-627
- Kand, D., I. Bagus Raharjo, J. Castro-Montoya, dan U. Dickhoefer. 2018. The effects of rumen nitrogen balance on *in vitro* rumen fermentation and microbial protein synthesis vary with dietary carbohydrate and nitrogen sources. *Animal Feed Science and Technology* 241: 184-197.
- Karsli, M. A. and J.R. Russell. 2001. Effects of some dietary factors on ruminal microbial protein synthesis. *Turky Journal Veterinary Animal Science*. 25: 681-686.
- Kholif A., T. Morsy, O. Matloup, U. Anele, A. Mohamed, A. El – Sayed. 2017. Dietary *Chlorella vulgaris* microalgae improves feed utilization, milk

- production and concentrations of conjugated linoleic acids in the milk of Damascus goats. *J. Agric. Sci.*, 155: 508–518
- Kholif, A. E., G. A. Gouda, dan H. A. Hamdon. 2020. Performance and milk composition of Nubian goats as affected by increasing level of *Nannochloropsis oculata* microalgae. *Animals* 10: 2453.
- Kim, E. T., L. Luo Guan, S. J. Lee, S. M. Lee, S. S. Lee, I. D. Lee, S. K. Lee, dan S. S. Lee. 2015. Effects of flavonoid-rich plant extracts on *in vitro* ruminal methanogenesis, microbial populations and fermentation characteristics. *Asian-Australasian Journal of Animal Sciences* 28(4): 530-537.
- Kong, L., C. Yang, L. Dong, Q. Diao, B. Si, J. Ma, dan Y. Tu. 2019. Rumen fermentation characteristics in pre- and post-weaning calves upon feeding with mulberry leaf flavonoids and *Candida tropicalis* individually or in combination as a supplement. *Animals* 9: 1-14.
- Kustantinah dan Adiwimarta. 2012. Pengukuran Kualitas Pakan Sapi PT. Citra Aji Parama. Yogyakarta.
- Li, M., F. Hassan, L. Peng, H. Xie, X. Liang, J. Huang, F. Huang, Y. Guo, dan C. Yang. 2022. Mulberry flavonoids modulate rumen bacteria to alter fermentation kinetics in water buffalo. *PeerJ* 10:1-26
- Li, S., S. Wang, Y. Zhu, R. Mu, T. Wang, Y. Zhen, H. Si, R. Du, dan Z. Li. 2025. *In vitro* dynamics of rumen microbiota and fermentation profiles with antler growth of Sika deer. *Microbiology Spectrum* 13(3): 20-24
- Liu, N., X. Xie, H. Jiang, L. Zhu, F. Yang, T. H. Nguyen, dan J. Liu. 2014. Variation of Total Volatile Fatty Acids (VFAs) and Its Components in Hydrolytic Acidification Treatment of Dyeing Wastewater. *Applied Mechanics and Materials* 651-653: 1384-1387.
- Liu, Q., C. Wang, W. Z. Yang, B. Zhang, X. M. Yang, dan D. C. He. 2009. Effects of isobutyrate on rumen fermentation, lactation performance and plasma characteristics in dairy cows. *Animal Feed Science and Technology* 154: 58–67.
- Ma, T., D. Chen, Y. Tu, N. Zhang, B. Si, dan Q. Diao. 2016. Dietary supplementation with mulberry leaf flavonoids inhibits methanogenesis in sheep. *Animal Science Journal* 88: 72-78.
- Mahaputra, S., dan P. Kurniadhi. 2003. Analisis Biaya Pemeliharaan Domba Dengan Complete Feed. *Buletin Teknik Pertanian*, 8(2): 47–48.
- Maia M.R.G., A.J.M. Fonseca, H.M. Oliveira, C. Mendonça, A.R.J. Cabrita. 2016. The potential role of seaweeds in the natural manipulation of rumen fermentation and methane production. *Scientific Report* 6: 32321.
- Maia, M. R. G., A. J. M. Fonseca, P. P. Cortez, dan A. R. J. Cabrita. 2019. *In vitro* evaluation of macroalgae as unconventional ingredients in ruminant animal feeds. *Alga Research* 40: 101481.
- Mao, H. L., J. K. Wang., Y. Y. Zhou., and J. X. Liu. 2010. Effects of addition of tea saponins and soybean oil on methane production, fermentation

- and microbial population in the rumen of growing lambs. *Livestock Science*. 129: 56-62.
- Mavrommatis, A., K. Sotirakoglou, D. Skliros, E. Flietakis, dan E. Tsiplakou. 2021. Dose and time response of dietary supplementation with *Schizochytrium* sp. on the abundances of several microorganisms in the rumen liquid of dairy goats. *Livestock Science* 247: 104489.
- McDonald, P., R.A. Edwards, J.F.D. Greenhalgh, dan C.A. Morgan. 2002. *Animal Nutrition*. Edisi ke-6. Prentice Hall, London.
- Medipally S.R., F.M. Yusoff, S. Banerjee, M. Shariff. 2015. Microalgae as sustainable renewable energy feedstock for biofuel production. *BioMed Research International* 1-13.
- Meehan, D.J., G. Maia, A.R.J. Cabrita, J.L. Silva, dan A.J.M. Fonseca. 2021. Effects of *Chlorella vulgaris*, *Nannochloropsis oceanica*, and *Tetraselmis* sp. supplementation levels on *in vitro* rumen fermentation. *Algal Research* 56: 1-10.
- Metiab, M. I., M. M. Khorshed, A. M. El-Essawy, M. S. Nassar, dan N. E. El-Bordeny. 2025. In vitro gas production and rumen fermentation for diets containing increasing levels of *Panicum maximum* cv. Mombasa with or without spirulina. *Tropical Animal Health and Production* 57: 25.
- Moor VJ, C.A. Pieme, P. C. Biapa, M. E. Matip, B. Moukette, F. Nzufu, P. Nan fack, J. Ngogang. 2016. Chemical composition of *Spirulina plantensis* of Nomayos-Yaounde (Cameroon). *Annals Food Sci Technol* 17: 524-528.
- Morgavi, D. P., W. J. Kelly, P. H. Janssen, dan G. T. Attwood. 2013. Rumen microbial (meta)genomics and its application to ruminant production. *Animal* 7: 184–201.
- Nagananthini, G., R. S. Rajapriya, A. Amuthan P. S., S. Sivasankari, dan D. R. A. Ravindran. 2020. Extraction and optimization of extracellular polysaccharide production in *Spirulina platensis* MK 343101. *International Journal of Scientific & Technology Research* 9(4): 12-17.
- Nisa, D., J. Achmadi, dan F. Wahyono. 2017. Degradabilitas bahan organik dan produksi total Volatile Fatty Acids (VFA) daun kelor (*Moringa oleifera*) dalam rumen secara *in vitro*. *Fakultas Peternakan dan Pertanian, Universitas Diponegoro, Semarang. Jurnal Ilmu-Ilmu Peternakan* 27 (1): 12-17
- Nohong, B. 2023. *Pertumbuhan, Produksi, dan Kualitas Rumput Gajah*. Penerbit Depublish Digital. Sleman. Yogyakarta.
- Oba, M., and M. S. Allen. 2003. Dose-response effects of intrauminal infusion of propionate on feeding behavior of lactating cows in early or midlactation. *J. Dairy Science* 86:2922–2931.
- Oskoueian, E., N. Abdullah, and A. Oskoueian. 2013. Effects of flavonoids on rumen fermentation activity, methane production, and microbial population. *BioMed Research Internasional* 1-8.

- Patra, A. K., dan Z. Yu. 2014. Combinations of nitrate, saponin, and sulfate additively reduce methane production by rumen cultures in vitro while not adversely affecting feed digestion, fermentation or microbial communities. *Bioresource Technology* 155: 129-135.
- Pazla, R., D. Febrina, dan D.N.I. Sari. 2023. *Fisiologi Pencernaan Ruminansia*. CV Adanu Abimata. Indramayu.
- Phang, S. M., M. S. Miah, W. L. Chu, and M. Hashim. 2000. *Spirulina Culture in Digested Sago Starch Factory Waste Water*. *Journal of Applied Phycology* 12: 395-400.
- Pitta, D. W., E. Pinchak., S. E. Dowd., J. Osterstock., V. Gontcharova., E. Youn., K. Dorton., I. Yoon., B. R. Min., J. D. Fulford., T. A. Wickersham., dan D. P. Malinowski. 2010. Rumen bacterial diversity dynamics associated with changing from bermudagrass hay to grazed winter wheat diets. *Microbial Ecology* 59: 511-522.
- Qosim, A. M., R.R. Dirgarini, J. N. Subagyo, dan R. Gunawan. 2024. Study on pyrolysis of microalgae (*Spirulina platensis*) to the concentration of carbohydrate derivative products. *Prosiding Seminar Nasional Kimia 2024*, Jurusan Kimia FMIPA UNMUL. eISSN 2987-9922.
- Ragaza, J.A., Hossain, M.S., Meiler, K.A., Velasquez, S.F., & Kumar, V., 2020. A review on spirulina: alternative media for cultivation and nutritive value as an aquafeed. *Reviews in Aquaculture*, 12(4): 2371–2395.
- Riswandi, M. A. A. Imsya, Jakfar, dan S. Ginting. 2017. Pengaruh Rumput Rawa dan Limbah Pertanian sebagai Penyusun Total Mixed Fiber (TMF) terhadap Kecernaan Serat Kasar Protein Kasar secara In Vitro. *Jurnal Peternakan Sriwijaya* 6(2): 70-78
- Russell, J. R., dan J. L. Rychlik. 2001. Factors that alter rumen microbial ecology. *Science* 292: 1119-1122.
- Saha U, Fayiga A, Hancock D, Sonon L. 2016. Selenium in animal nutrition: deficiencies in soils and forages, requirements, supplementation and toxicity. *International Journal Applied Agriculture Science* 2: 112-125.
- Sajati, G., Prasteyo, B.W.H.E. Surono, 2012. Pengaruh ekstrusi dan proteksi dengan tannin pada tepung kedelai terhadap produksi gas total dan metan secara In vitro. *Animal Agricultural Journal* 1: 241–256
- Salehian, Z., H. Khalilvandi-Behroozyar, N. Ahmadifard, H. Almasi, R. Pirmohammadi, G. Buendía Rodríguez, M. Lackner, dan A.Z.M. Salem. 2025. The effect of supplementing *Nannochloropsis oculata* microalgae on ruminal fermentation, methane production and microbial population. *Journal of Agriculture and Food Research* 19: 1-8.
- Simon dan P. Ginting. 2005. Sinkronisasi degradasi protein dan energi dalam rumen untuk memaksimalkan produksi protein mikrobia. *Wartazoa* 15(1): 1-10.

- Spolaore, P., C. J. Cassan, E. Duran dan A. Isambert. 2006. Review commercial applications of microalgae. *Journal of Bioscience and Bioengine* 101(2): 87-96.
- Sucu, E. 2020. Effects of microalgae species on in vitro rumen fermentation pattern and methane production. *Annals of Animal Science* 20: 207–218.
- Sucu, E. 2023. In vitro studies on rumen fermentation and methanogenesis of different microalgae and their effects on acidosis in dairy cows. *Fermentation* 9: 229.
- Sucu, E., D. Udum, N. Güneş, dan Ö. Canbolat. 2017. Influence of supplementing diet with microalgae (*Schizochytrium limacinum*) on growth and metabolism in lambs during the summer. *Turkish Journal of Veterinary & Animal Sciences* 41: 167-174.
- Sudha S.S., R. Karthic, Naveen, J. Rengaramanujam. 2011. Anti hyperlipidemic activity of *Spirulina platensis* in triton x-100 induced hyperlipidemic rats. *Hygea Journal for Drugs and Medicines* 3(2): 32-37.
- Suhartanto, B., Kustantinah dan S. Padmowijoto. 2000. Degradasi in sacco bahan organik dan protein kasar empat macam bahan pakan diukur menggunakan kantong inra dan rowett research institute. *Buletin Peternakan*. Vol 24(2): 82-93.
- Suwandyastuti, S.N.O. dan E.A. Rimbawanto. 2015. Produk metabolisme rumen pada sapi perah laktasi. *Agripet*. 15(1): 1-6.
- Syahrir, S., K. G. Wiryawan, A. Parakkasi, M. Winugroho dan O.N.P. Sari. Efektivitas Daun Murbei Sebagai Pengganti Konsentrat dalam Sistem Rumen in Vitro. *Media Peternakan* hal. 112-119.
- Tao, M.A., D.-D. Chen, Y. Tu, N.-F. Zhang, B.-W. Si, dan Q.-Y. Diao. 2016. Dietary supplementation with mulberry leaf flavonoids inhibits methanogenesis in sheep. *Animal Science Journal* 1-7.
- Tedeschi, L. O., J. E. Shirley, R. J. Koenig, A. N. De Oliveira Silva, D. J. Seo, M. D. Hanigan, dan E. Kebreab. 2023. Forages and Pastures Symposium: Revisiting mechanisms, methods, and models for altering forage cell wall utilization for ruminants. *Journal of Animal Science*, 101: 1-21
- Wang, Z., Y. Liang, J. Lu, Z. Wei, Y. Bao, X. Yao, Y. Fan, F. Wang, D. Wang, dan Y. Zhang. 2021. Dietary spirulina supplementation modifies rumen development, fermentation, and bacteria composition in Hu sheep when consuming high-fat dietary. *Frontiers in Veterinary Science* 8: 1-12.
- Wei, C., J. Guyader, L. Collazos, K. A. Beauchemin, and G. Y. Zhao. 2018. Effects of gallic acid on in vitro rumen fermentation and methane production using rumen simulation (Rusitec) and batch-culture techniques. *Animal Production Science* 58(3): 431-440
- Wei, H., J. Liu, M. Liu, H. Zhang, dan Y. Chen. 2024. Rumen fermentation and microbial diversity of sheep fed a high-concentrate diet

- supplemented with hydroethanolic extract of walnut green husks. *Anim Biosci* 37(4): 655-667.
- Widianingrum, D.C., S.I.O Salasia, dan C.T. Noviandi. 2019. Kecernaan dan karakteristik fermentasi rumen in vitro ransum ruminansia dengan suplementasi virgin coconut oil terproteksi. Prosiding, Seminar Nasional Teknologi Peternakan dan Veteriner.
- Widyobroto, B.P., S.P.S. Budhi, dan A. Agus. 2007. Pengaruh aras undegraded protein dan energi terhadap kinetik fermentasi rumen dan sintesis protein mikrobial pada sapi. *Journal of the Indonesian Tropical Animal Agriculture* 32(3): 194-200.
- Yudiati, E., Sedjati, S., Azhar, N., Oktarima, W.A., & Arifin, Z., 2021. *Spirulina* Water Extract and *Lactobacillus bulgaricus* FNCC – 0041, *Streptococcus thermophilus* FNCC – 0040 Secretion as Immunostimulants in Gnotobiotic Artemia Challenge Tests Against Pathogenic *Vibrio parahaemolyticus*, *V. vulnificus*, and *V. harveyi*. IOP Conference Series: Earth and Environmental Science 890(1): 1–7.
- Zdunczyk, Z., J. Jus´kiewicz, dan I. Estrella. 2006. Cecal parameters of rats fed diets containing grapefruit polyphenols and inulin as single supplements or in a combination. *Nutrition* 22: 898–904.
- Zhang, J., Gao, Y., Li, Q., Shang, Q., Chen, Y., Jiang, W., dan Gao, J. 2020. Effects of dietary supplementation with fermented and non-fermented *Cordyceps militaris* on growth performance, antioxidant capacity and immune response in weaned piglets. *Animal Nutrition* 6(4): 369-376.
- Zong, Y., Cheng, Z., Ji, H., Sun, S., Su, Y., Wu, Z., Lin, M., Zhou, X., dan Liu, L. 2024. Composition Analysis of Defatted *Moringa oleifera* Seed Extracts and Their Effects on Rumen Fermentation and Bacterial Community Structure in Vitro. *Chinese Journal of Animal Nutrition*. 36(8): 5152-5169.
- Zulpikar, F., R. Naufalin, Erminawati, A. Gandhy, D. Novitasari, dan W. El Kiyat. 2019. Analisis kelayakan usaha budidaya spirulina skala rumah tangga. Prosiding Seminar Nasional dan Call For Papers hal. 68-77.